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THE FLORA OF GUADALUPE ISLAND, MEXICO

By

Reid Moran

Published by the California Academy of Sciences

San Francisco, California

Memoirs of the California Academy of Sciences, Number 19

The pride of Guadalupe Island, the endemic *Cistanthe guadalupensis*, flowering on a small islet off the southwest coast, with cliffs of the main island as a background; 19 April 1957. This plant is rare on the main island, surviving only on cliffs out of reach of goats, but common here on goatless Islote Negro.

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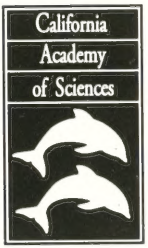

Published by the California Academy of Sciences

San Francisco, California

Memoirs of the California Academy of Sciences, Number 19

San Francisco
July 26, 1996

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Library of Congress Catalog Card Number: 96-084362
ISBN 0-940228-40-8

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THE FLORA OF GUADALUPE ISLAND, MEXICO

By

Reid Moran

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Guadalupe Island is a volcanic oceanic island 260 km west of the peninsula of Baja California, Mexico, and separated by ocean depths of 3600 m. Its area is 250 km^2 and its height 1295 m. Rainfall averages 133 mm near sea level at the south end but evidently is much more at the high north end, where there is no record. For at least a century and a half, feral goats have degraded the island by destroying the vegetation, thus (1) extinguishing native species, (2) fostering soil erosion, and (3) drying up springs by killing trees whose fog drip had added greatly to rainfall.

Once-extensive forests of pine, oak, and cypress on the high northern third of the island, and woods of juniper and palms (*Brahea*), have shrunk drastically and are still shrinking, the remaining old trees unable to reproduce because goats eat the seedlings. Sage scrub (*Senecio* etc.) in the northern half of the island has been replaced by weedy grasslands, with shrubs surviving only on cliffs and some kinds gradually dying out. Some scrub (*Ambrosia*, *Atriplex*, *Lycium*, *Hemizonia*) remains at low levels in the drier southern third of the island, where fewer goats range for lack of water. Offshore islets are refugia for rare plants, including five never found on the main island.

The total known vascular flora is 216 species, but not all there at one time: over 30 of them are probably now extinct on the island, and new weeds keep coming as if to take their place. Whatever we may mean by native on a volcanic oceanic island, I count 45 species, mainly European weeds, as relative newcomers, thus leaving at most 171 to consider as possibly native. However, a dozen of these were first found in parts of the island where earlier collectors had failed to find them. The cumulative evidence is that some must be recent arrivals; but not knowing which are, I keep 15 west American plants in the category of possibly or probably introduced, leaving 156 as less doubtfully native. Of these natives, 34 species and subspecies (21.8 percent) are endemic, including the monotypic genera *Baeriopsis* J. T. Howell and *Hesperelaea* A. Gray, though five or more endemics are extinct. Of the native flora, 114 species (73 percent) grow also in Alta California and only eight (5 percent) in Baja California but not northward. In particular, 101 (65 percent) grow on California islands; and 19 of these (12.2 percent) are insular endemics. Of the Guadalupe endemics, six have closest relatives on other islands. Thus the relationships of the Guadalupe flora are mainly to the north, with the islands of southern California: Guadalupe Island is an outlier of the California Floristic Province.

It is most important before more plants are lost, to remove all goats from the island, reversing the process of degradation and encouraging in every way the renewal of the natural vegetation. Even at best, some rare plants may die out unless propagated and replanted. Guadalupe Island with its unique flora is a Mexican national treasure in dire need of protection.

Received March 3, 1995. Accepted June 6, 1995.

Resumen

La Isla de Guadalupe is una isla oceánica volcánica situada a 260 km al oeste de la peninsula de Baja California, México, y separada por profundidades oceánicas de 3600 m. Su área es de 250 km cuadrados y su altitud alcanza 1295 m. La precipitación pluvial promedia 133 mm cerca del nivel del mar en el extremo sur pero evidentemente is mucho mas en el elevado extremo norte, donde no existen registros. Por cuando menos un siglo y medio, las cabras ferales had degradado la isla destruyendo la vegetación, de esta manera (1) extinguiendo especies nativas, (2) propiciando erosión del suelo, y (3) secando manantiales al matar árboles cuya condensación de niebla complementaba grandemente la lluvia.

Los en un tiempo extensos bosques de pinos, encinos, y cipreses, en el elevado tercio norte de la isla, y montes de enebros y palmeras (*Brahea*) se han reducido drásticamente y continúan reduciéndose, los árboles viejos remanentes imposibilitados para reproducirse por que las cabras devoran los renuevos. El matorral de salvia (*Senecio* etc.) en la mitad norte de la isla, ha sido reemplazado por maleza de pastizales, con arbustos sobreviviendo únicamente en acantilados y algunos gradualmente muriendo. Algún matorral (*Ambrosia*, *Atriplex*, *Lycium*, *Hemizonia*) permanece a bajos niveles en el mas seco tercio del sur de la isla, a donde van menos cabras por falta de agua. Los islotes litorales son refugios para plantas raras, incluyendo cinco que nunca se han encontrado en la isla principal.

La flora vascular total conocida es de 216 especies, pero no todas al mismo tiempo: mas de 30 de ellas probablemente se han extinguido ya de la isla, y nuevas malezas siguen llegando como para tomar su lugar. De lo que de alguna manera consideremos nativo en una isla volcánica oceánica, yo recuento 45 especies, principalmente malezas europeas, como arribos relativamente recientes, así dejando cuando mucho 171 que se consideran posiblemente nativas. Sin embargo, una docena de éstas fueron por primera vez encontradas en este siglo, en partes de la isla donde no las habían hallado recolectores anteriormente. La evidencia acumulativa es de que algunos son arribos recientes; pero no sabiendo cuales son, yo mantengo 15 plantas oeste-americanas en la categoría de posible o probablemente introducidas, dejando 156 como menos dudosamente nativas. De estas especies nativas, 34 especies y subespecies (21.8 porciento) son endémicas, incluyendo los géneros monotípicos *Baeriopsis* J. T. Howell y *Hesperelaea* A. Gray, aunque cinco o mas endémicas están extinguidas.

De la flora nativa, 114 especies (73 porciento) crecen también en Alta California y únicamente ocho (5 porciento) crecen en Baja California pero no mas al norte. En particular 101 (65 porciento) crecen en las islas de California; y 19 de éstas (12.2 porciento) son endémicas insulares. De las endémicas de Guadalupe, seis tienen sus mas cercanas especies emparentadas en otras islas. Así, las relaciones de la flora de Guadalupe se encuentran principalmente al norte, con las islas del sur de California; la isla de Guadalupe es un desplazamiento de la Provincia Floristica de California.

Es de la mayor importancia antes de que se pierdan mas plantas, remover todas las cabras de la isla, revirtiendo el proceso de degradación y fomentando en todas las formas posibles la recuperación de la vegetación natural. En el mejor de los casos, algunas plantas raras no podrán sobrevivir a menos que puedan ser propagadas de semillas nativas y replantadas.

La isla de Guadalupe con su singular flora, es un tesoro nacional mexicano en desesperada necesidad de protección.

Introduction

Guadalupe Island, westernmost outpost of Mexico, is a volcanic oceanic island some 260 km (162 statute miles) off the peninsula of Baja California, 337 km (210 miles) southwest of Ensenada, and 400 km (250 miles) south-southwest of San Diego, California (Fig. 1). It is separated from the continent by ocean depths of some 3600 m (2000 fathoms) and evidently has never been connected.

Like other high oceanic islands, Guadalupe is remarkable for endemism in the flora and fauna; but it is a naturalists' paradise despoiled by feral goats, housecats, and mice. These pests need to be exterminated before they destroy more of the unique endemics of this remarkable island; and it is important to reverse the desertification, which in the long run threatens even the goats themselves. Pending removal of all goats, fenced exclosures could help the recovery of rare plants now close to extinction; but even so, some rare ones might not survive unless they could be propagated, of course from native seed, and replanted. As further insurance, botanic gardens on the mainland can help preserve genetically adequate samples and seeds of Guadalupe plants. Perhaps the Center for Plant Conservation could slightly extend its area of concern to include this southernmost outlier of the California Floristic Province and could coordinate the effort. Meanwhile the Rancho Santa Ana Botanic Garden is starting to help with this work.

Indeed, relationships of the vascular flora are mainly to the north, with the Channel Islands of southern California, and to some extent with the islands off northwest Baja California (Fig. 1). Hence the flora is of particular interest to Californian botanists like me. Thorne (1969) described these islands as to area, height, distance from the mainland and from each other, and geological history; and for these islands he discussed disharmonic biotas, immigrant patterns of distribution, relict and autochthonous endemism, gigantism, continuous flowering, hybridization, and vulnerability. Wallace (1985) tabulated the known floras of the eight Channel Islands plus Guadalupe, but there has been no full account of the Guadalupe flora. So at last, here it is.

Guadalupe Island

Description

Guadalupe Island (Fig. 2) is about 37 km (23 miles) long north and south, 12 km (8 miles) wide, and 1295 m (4257 feet) high, with an area of about 250 km^2 (98 square miles). It is rather uniformly high in the northern third, the highest point, Mt. Augusta, scarcely rising above the general level. In the southern half is one rather sharp 975-meter (3200-foot) peak, El Picacho. From there, the surface drops away to rather low elevations at the south end, with scattered cones and craters (Fig. 16). Two of these features form islets offshore: Inner and Outer Islets (Fig. 17).

The island is a seamount built on the axis of a fossil ridge crest or spreading center, starting at most 10 million years after the abandonment of the ridge and perhaps much earlier (Batiza 1977). The island consists of two partly overlapping shield volcanoes, both collapsed calderas, vestiges of the southern one at El Picacho, the younger northern one remaining as a half-crater at the north end (Figs. 3, 4). These are largely overlain by a thick series of flank and fissure eruptions, from a set of north-trending fissures marked by lines of cinder cones. Volcanic rock types form a remarkably complete series from alkali olivine basalt to trachyte. The oldest exposed rocks are subaerial flows of alkali

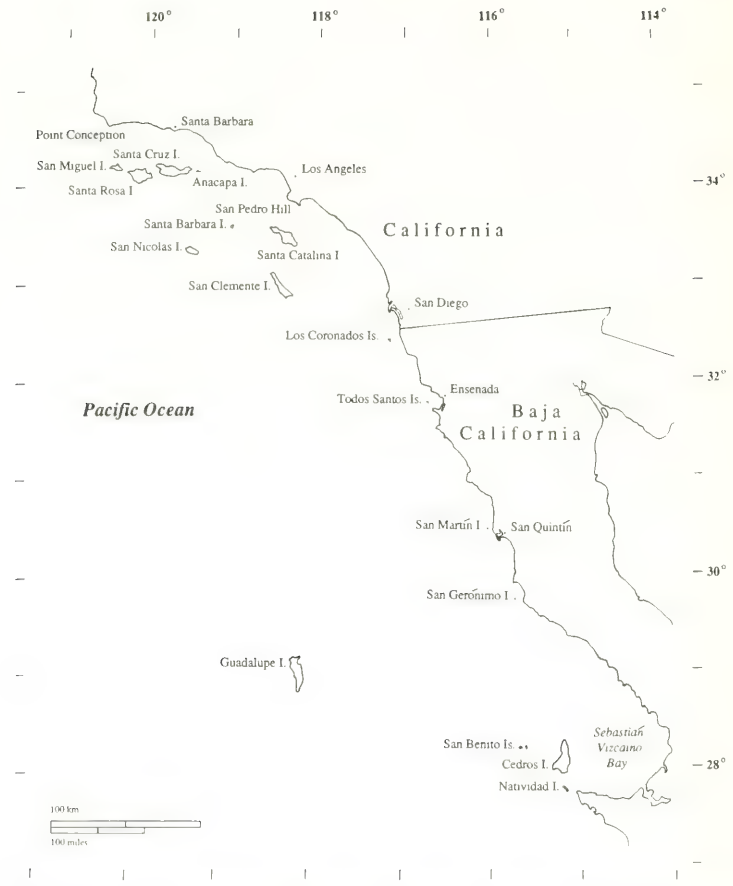


FIGURE 1. The California Islands, off southern California and northwest Baja California. Based on Hydrographic Office Chart 5760, 1942.

olivine basalt radiometrically dated at 7 ± 2 million years BP (Engel and Engel 1964, 1971).

The northern upland is what remains of a caldera about 10 km (6 miles) wide, whose collapsed eastern side is eroded away by streams forming two large canyons. The western rim of the caldera is the main ridge of the island, which from the high point at Mt. Augusta curves around to the north and northeast, to end in North Point, the northern tip

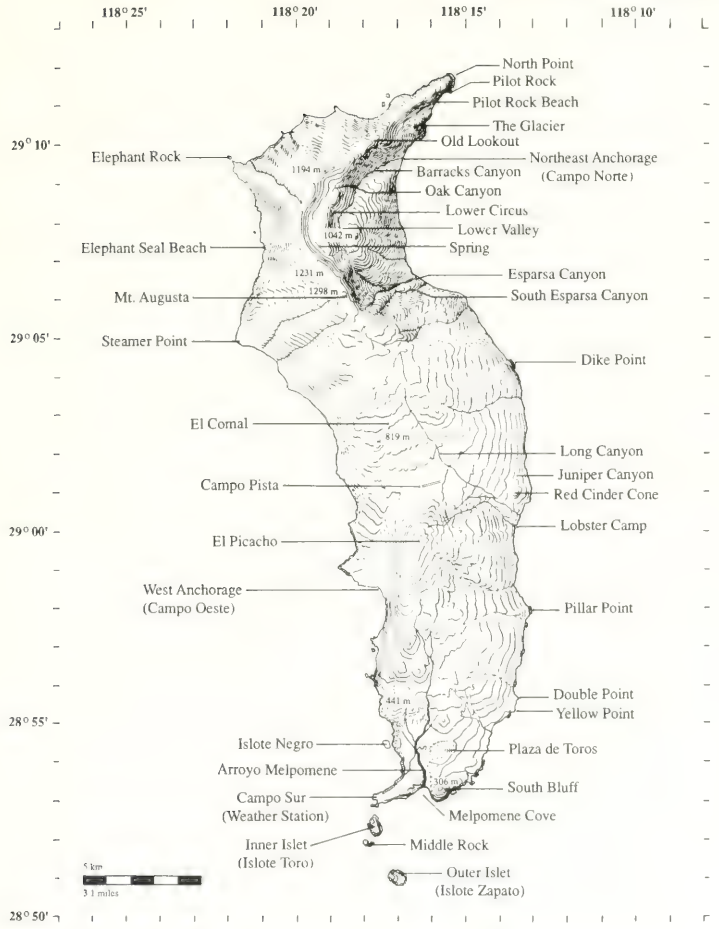
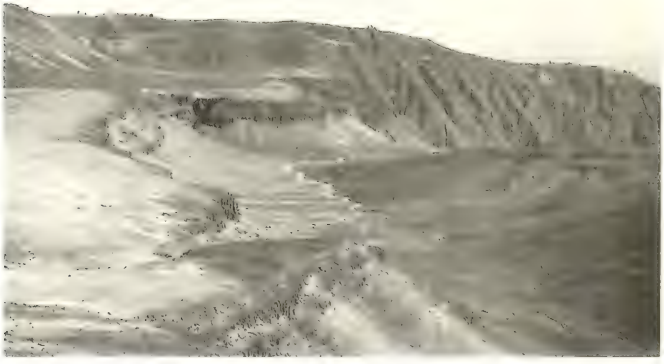


FIGURE 2. Guadalupe Island, with place names used in this flora. Based on USDMA Chart 21661, 12th edition, 1982.

of the island (Figs. 3, 4). Below the rim in the caldera is an irregular shelf or upper valley (Fig. 3). Here is the only permanent spring left on the island (Fig. 5), evidently fed partly by fog drip from the cypress grove west of the ridge; in August 1981 it was flowing at a constant 0.275 liters/second (González 1981). Early visitors described other springs nearby, and according to Greene (1885), the springs fed plenty of shallow and tepid pools.



FIGURES 3 and 4. Northeast upland, north from Mt. Augusta, the remnant of a caldera collapsed and eroded away to the east (right); 2 March 1965. The far rim is the northeast ridge of the island, ending in North Point to the right. FIGURE 3. Upper valley, draining south and then east, to Esparsa Canyon (see Figs. 7, 8). Near the middle of the picture is the principal spring of the island (see Fig. 5). FIGURE 4 (view to the right of Fig. 3). Lower Circus or inner arc of cliffs, and below it the lower valley, the near end draining into Esparsa Canyon, the far end into Barracks Canyon (see Fig. 9).

These springs have since dried up, doubtless from the loss of much of the cypress grove. Stewart (1965) mentioned three sizable springs still there in 1899; and springy places still remained north of the principal spring into the late 1950s. Here there was once a ranch, or probably a series of ranches, mentioned but not described by early visitors; adobe ruins seen near the spring as late as 1958 are now gone, but others to the northeast have not yet entirely melted away.

Just to the east in the caldera is a lower, inner arc of cliffs, which Franceschi (1893c) called the Lower Circus, and below this a lower valley (Figs. 4, 6). The caldera drains to the east, mainly by the two largest canyons of the island, Esparsa Canyon (Figs. 7, 8) on the south and Barracks Canyon (Fig. 9) on the north.

At the mouth of Barracks Canyon is Northeast Anchorage, for many years the main landing on the island (Fig. 10). It has been the site of various settlements — of fishermen, goathunters, and soldiers. Just above the beach are two conspicuous old white buildings known as the barracks, probably dating from World War II. At my first visit in 1948 the remains of a goatmeat cannery were still to be seen on the beach. A broad trail climbed by zigzags out of the canyon, then up the east slope and through the lower valley to the spring and the cypress grove. The landing is now called Campo Norte. It is connected by road, by way of the spring, with the airfield (Campo Pista) near the middle of the island, and that with Campo Oeste at West Anchorage and with Campo Sur at the southwest corner of the island.

Seacliffs are high, especially around the northern end. North Point, actually the northeast point, stands 400 m above the sea. The north end has seacliffs 500 or 600 m high and a steep slope above (Fig. 11), and at the northwest corner of the island, exposed to the full force of the Pacific swell, slightly more rounded cliffs are some 700 m high. Two-thirds of the way down the west coast, west of and below El Picacho, is a break in the cliffs — West Anchorage, an indifferent anchorage but sheltered from the north (Figs. 12, 13). Over the years this was first a camp for sealers near a major rookery of the fur seals (Anthony 1925, Hanna 1925), then more recently a seasonal fish camp, sometimes with lobster or abalone fishermen, but now is part of the naval base and known as Campo Oeste. Rather high cliffs again, continue to the south end (Fig. 13).

Another old rookery and sealing camp was on the low-lying southwest point of the island. A marine base and weather station (Fig. 14) founded there in December 1946 was for many years the only permanent settlement on the island; it is now called Campo Sur. Just to the east is the south-end mesa (Figs. 31, 32), about 100 m high, with cliffs along the south side facing Melpomene Cove. At the southeast corner of the island is South Bluff, a rounded butte 310 m high (Fig. 32). Just west of South Bluff is the mouth of Arroyo Melpomene, which rises on the slopes of El Picacho, some 9 km to the north.

Close off the southwest coast is a small islet about 30 m (100 feet) high called Islote Negro (Fig. 15). Prominent off the south end are two larger islets, Inner Islet and Outer Islet (Figs. 16, 17). Inner Islet is a rounded dome 227 m (744 feet) high, with vegetation on top and sheer cliffs below. Outer Islet is a seabound volcanic crater 206 m (677 feet) high, with sheer cliffs on all sides but the northwest. There the sea has eaten farther into the side of the crater, leaving only a low rim (Fig. 48), with a rocky slope down to the water, where on a calm day it is possible to jump ashore onto the rocks and scramble up into the crater. The floor of the crater is flat, and its sides slope up uniformly at about 45°, on most sides to a jagged rim topping the sheer outer cliffs (Fig. 34). But above on the east side is a shallow hanging valley, a subsidiary crater, at 190 m (Fig. 35).

FIGURE 5. The spring, in upper valley, now the only permanent spring on the island, evidently fed by fog drip on west side of ridge; 26 April 1958. With the loss of many trees, other springs of this valley have dried up

FIGURE 6. Lower valley and cliffs of the Lower Circus, looking south to Mt. Augusta, with eastern fringe of cypress grove beyond; 25 April 1958

FIGURE 7. Southern rim of the collapsed caldera (right): looking east down Esparsa Canyon from Mt. Augusta, 26 April 1958.

FIGURE 8. Mouth of Esparsa Canyon, on east side of the island, with Mt. Augusta and eastern fringe of cypress grove on the skyline; 24 April 1958.

FIGURE 9. Barracks Canyon, with Northeast Anchorage at the mouth, the skyline with Mt. Augusta in the middle; 22 April 1958.

FIGURE 10. Northeast Anchorage, with the old barracks, 10 April 1948. The two pines on the skyline are at the old lookout, at 800 m (see Fig. 42). The shrubs in the canyon mouth are the recently arrived tree tobacco (*Nicotiana glauca*, *M2838*), shunned by the goats and so spreading and now threatening to take the island.

FIGURE 11. North end of the island, with 500-meter cliffs, 17 April 1957. On the skyline are pines (*Pinus radiata* var. *binata*), on the slopes many palms (*Brahea edulis*) and a few scattered pines.

Around the corner of the main island, on the east and leeward side, the seacliffs are lower than on the west. Near the south end are the ruins of another old sealing camp, used supposedly in the first part of the last century to house Aleutian islanders brought by Yankee fur sealers to do the dirty work (Hanna 1925).

Farther north are several canyons or arroyos much shallower than Esparsa Canyon and Barracks Canyon in the northeast.

PLACE NAMES

The map (Fig. 2) shows place names used in this flora. On U. S. Hydrographic Office Chart 1688, from which I made my early labels for Guadalupe plants, the few long-established place names are mostly English, though on Mexican maps many are now translated or replaced. The newer Mexican names include "Campo Norte" for Northeast Anchorage, in the old reports simply called "the landing"; "Campo Oeste" for West Anchorage or Jacks Bay or Campo Tepeyac; "Campo Sur" for the weather station or marine base at the southwest corner of the island; "Campo Pista" at the air field; and "Campo de Lima" for what was called the Lobster Camp. Dr. Carl Hubbs (Peterson et al. 1968, fig. 1) improvised such names as he needed to record his observations along the coast, such as Islote Negro, Double Point, Dike Point, Yellow Point. Likewise, I have informally coined a few names for plant labels, like "Oak Canyon," "South Oak Canyon," and "Hemizonia Cliff." "Esparsa Canyon," from Hanna (1925), replaces "North Twin Canyon" of my early labels; and "South Twin Canyon" becomes "South Esparsa Canyon." Possibly this name is a variant of Espaza, used by Palmer as Espaza Bay, apparently for an indentation on

FIGURES 12 and 13. West Anchorage, a break in the cliffs two-thirds of the way down the west coast; 17 April 1957. FIGURE 12. View from the west. FIGURE 13. The anchorage from the north, with Scripps vessel *Paolina T*, the high cliffs continuing on southward towards Inner Islet.

FIGURE 14. The village and weather station at the southwest corner of the island, 14 April 1970 Founded in 1946, it has now grown into Campo Sur.

FIGURE 15. Islote Negro, off the southwest coast, a goatless refugium for south-end plants; 29 April 1958. (See FRONTISPIECE.)

FIGURE 16. South end of the island from the summit of El Picacho, showing Inner Islet and Outer Islet off the south coast; 16 April 1970.

FIGURE 17. Outer Islet (left), a seabound volcanic crater, and Inner Islet, south of the main island; 22 August 1981. Outer Islet is a museum of plants rare or extinct on the main island; Inner Islet is out of reach and tantalizing.

the north coast (Watson 1876:119). Esparsa Canyon probably is what Palmer once referred to as Landrum's Cañon (Watson 1876:119) and Brandegee (1900) called Sparmann's Cañon. I have adopted Franceschi's (1893c) term "Lower Circus" for the lower, inner arc of cliffs remaining from the huge caldera that formed the northeast part of the island, i.e. the cliffs below and east of the spring where the earliest collectors camped. The Old Lookout is the site of the two ruined stone huts (Fig. 42) at 800 m on the main north ridge above and west of Northeast Anchorage. Melpomene Cove at the south end has also been known as Whalers Bay or South Bay. The main arroyo at the south end I have called Arroyo Melpomene. Inner Islet or Isla de Adentro is also known as Islote Toro, and Outer Islet or Isla de Afuera was called Zapato as early as Palmer's day (Safford MS). However, these names have sometimes been reversed (e.g. by Berzunza 1950:28); and the present names are unambiguous. Since my place names are a mixture of English and Spanish, I am taking the easiest course in an English-language account and calling the island Guadalupe Island rather than Isla Guadalupe or Isla de Guadalupe.

Climate

The climate of Guadalupe Island is largely controlled by weather systems from the north. In an occasional year a tropical storm from the south, most likely in August through October, may bring heavy rainfall, strongly skewing the means from usual rainfall figures.

The low south end of the island, with south exposure, is comparatively desertic, but with frequent fogs as the abundance of lichens suggests. At Campo Sur (6.4 m elevation) near the southwest corner of the island is a Mexican government weather station, the only source of weather data for the island. Hastings and Humphrey (1969) gave incomplete monthly rainfall and temperature records for nearly ten years between 1951 and 1963 from this station. They showed rainfall ranging from 14 mm in 1951 to 88 mm in 1952 and to 693 mm in the exceptional year of 1962 (including 383 mm for March). The mean annual rainfall was 129.3 mm, distributed as follows: 60.4 mm (44.7 percent) in winter, 61.4 mm (45.5 percent) in spring, 2.7 mm (2 percent) in summer, and 10.5 mm (7.8 percent) in fall. For 1975 to 1981 González (1981) reported a mean annual rainfall of 110.7 mm, mostly in December, January, and April. Figure 18 shows mean monthly rainfall and temperatures for 1987 to 1993. For this period rainfall ranged from 11 mm in 1988 to 283 mm in 1991, with a mean of 162.0 mm, distributed as follows: 96.0 mm (59.3 percent) in winter, 9.2 mm (5.7 percent) in spring, 14.2 mm (8.8 percent) in summer, and 42.6 mm (26.3 percent) in fall. Comparison of the figures for these three data periods shows the inadequacy of such short records in this arid region intruded by rare tropical storms. The average for these 20 years of record is an annual rainfall of about 133 mm.

The much higher northern part of the island can be expected to have more rainfall, and from the vegetation (including *Pinus radiata*) and from experience (in fact, from several wet experiences) I am sure it does; but there is no record. As a first estimate for the high north end, we might take the rainfall for other places where *Pinus radiata* is native and where it is successfully grown. Dr. William Libby, a student of this pine, told me it grows best with about 750 mm of rainfall but under some conditions can survive with as little as half that much. The effective moisture, of course, is much greater because of fog drip.

Bryant (1887) wrote that fogs were dense and, driven by high winds, swept across the island and saturated it like rain. He wrote that though rains were not heavy, the runoff sent small torrents rushing down the arroyos. But in fact, rains can sometimes be very heavy: I have seen mudflows, rolling rocks, a muddy torrent flowing out of Esparsa Canyon, and waterfalls over the cliffs. Vegetation is now so sparse that runoff and erosion

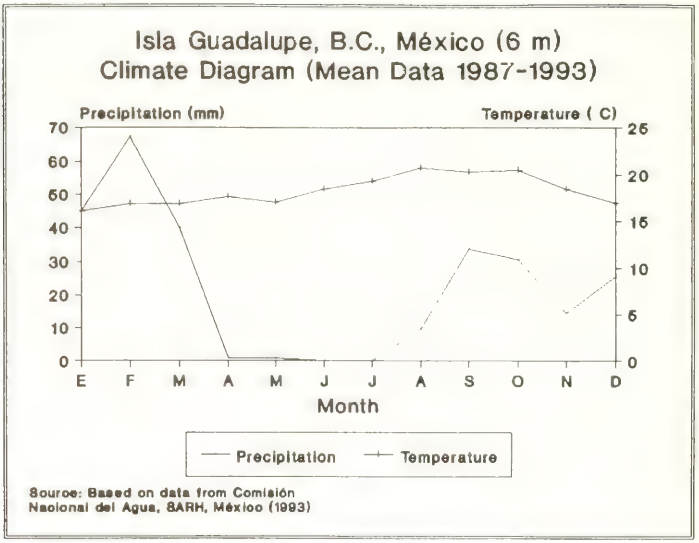


FIGURE 18. Mean monthly rainfall and temperature for 1987 to 1993 at the south end of Guadalupe Island. Diagram by José Delgadillo.

are rapid. Between 1957 and 1988 I noted the loss of 8 out of 9 oaks in Oak Canyon through undermining by the torrent that flows after rains, and the last oak is now reported gone.

Before the prevailing northwest winds, clouds often bank up against the north end of the island (Fig. 21), and Palmer wrote that fogs prevalent in winter are driven by strong, cold northwest winds over the crest of the island. At other times clouds tend to dissipate southward on the usually warmer south slopes. Moisture from the clouds, or fog (depending on the point of view), condenses on the pine needles and cypress branchlets and drips to the ground in big drops like rain, making the ground wetter there than elsewhere, enabling these trees to grow there. The pines grow on the north slope (Figs. 19–21), right up to the crest of the ridge where the clouds commonly dissipate, but no farther (Fig. 22). Fog drip from pines and cypress evidently helps feed the springs at the north end. With the loss of the great groves of the past, other springs of earlier days have dried up, and continued loss of trees portends further drying and desertification of the island.

Hastings and Humphrey (1969) showed an annual mean temperature at the south end of 17.2°C, the means for different years ranging from 16.6°C to 17.6°C. Mean temperatures by season were: 15.4°C for winter, 16.1°C for spring, 18.4°C for summer, and 18.8°C for fall. For 1975 to 1981 González (1981) reported a monthly mean temperature of 17.9°C, varying from 16.2°C for April to 20.4°C for October. For 1987 to 1993 the mean annual temperature was 18.2°C.

At the high north end not only is rainfall greater but temperatures clearly are lower, though again there is no record. Lower temperatures result partly from the elevation but especially from the frequent fog and cloud cover. Several authors report ice and snow in winter. Palmer (Watson 1876) wrote that in December 1874 ice an inch thick formed in the middle of the island, accompanied by two inches of snow and followed by hail and five days of rain. Bryant (1887) wrote that the nights at that season (Dec.–Mar.) were so cold that ice occasionally formed and frost was of common occurrence. A heavy snowfall was reported for the winter of 1948–49 (Moran and Lindsay 1950).

A suggestion of a formerly warmer climate comes from Pleistocene fossils interpreted as of Sangamon Interglacial age (Hubbs and Jehl 1976).

History

Berzunza (1950) told something of the history of the island and listed scientific expeditions and conservation efforts for marine mammals. Nelson (1921) summarized scientific work until 1911 in Baja California, including Guadalupe. For an account of the botanical work, see Plant Collectors, p. 44.

In October 1602, according to Berzunza, Sebastián Vizcaíno sighted a large island which from its position must have been Guadalupe. First to survey the island and chart it accurately was French Admiral Abel du Petit-Thouars, on the *Venus* in November 1837 (du Petit-Thouars 1956). He noted that it ordinarily served as landfall for the galleons returning from the Philippines, which then went on to sight Cape San Lucas and continued to Acapulco.

President López Portillo of Mexico visited Guadalupe Island September 28, 1980, and reportedly ordered studies to find how the island could best be used for the good of the Mexican people. The Secretaría de Agricultura y Recursos Hidraulicos (SARH), contracted with Ecoterra of Chihuahua, headed by biologist Dr. Martin H. González, for a preliminary inventory of the natural resources of the island (González 1981).

Other Biota

The high oceanic island of Guadalupe is noted not only for its vascular flora but also for endemism in birds and land snails. Readers may therefore wonder what is known of these and other biota. Often that is little or nothing, from a few chance collections or none.

Crum and Miller (1956) summarized collections of bryophytes, at 26 mosses and 8 hepatics, calling the flora distinctly Californian. Crum (1972) added two more mosses. Bonar (1939) reported three fungi, incidentally collected.

First to make thorough collections of lichens was William A. Weber in 1963, who reached the eastern side of the island and the south end but not the higher north end; he accounted for 104 species (Weber 1994). He found the lichen flora, like the vascular flora, more closely related to that of southern California and its islands than to that of Baja California. Because the lichens are a pristine remnant of a rich flora now largely gone from coastal southern California, he proposed that the southern part of the island be designated a lichen reserve.

No land mammals, reptiles, or amphibians have been found native on the island, but in addition to the goats, house mice arrived by 1875 and house cats by 1885; and now there are wild dogs on the northwest slope. The Guadalupe fur seal and the elephant seal, of

FIGURE 19. Pine grove (*Pinus radiata* var. *binata*) on the west slope of the northeast ridge, with pines more scattered above; from near North Point, 22 April 1958.

FIGURE 20. Palm (*Brahea edulis*) and pines (*Pinus radiata* var. *binata*) on the northeast ridge, seen from the west, 13 April 1948.

FIGURES 21 and 22. Northeast ridge with the pine grove (*Pinus radiata* var. *binata*). FIGURE 21. Clouds banked up against the ridge, 3 May 1967. Moisture from the clouds condenses on the pine needles and falls like rain, watering the pines, enabling them to grow there. (Oaks in foreground.) FIGURE 22. Ridge from the south side, 13 April 1948. The pines come just to the crest but no farther because the clouds commonly dissipate as they blow across to the hotter, drier south side.

course, are associated with Guadalupe not as endemics but because the island was the sanctuary where a few somehow escaped the hunters in the last century and later, under protection of the Mexican government, could recover to spread again; see Anthony (1925) and Peterson et al. (1968).

From Palmer's notes and small collection, Ridgway (1876) listed eight species and races of landbirds, naming all eight as new — though one is now assigned to a mainland form. Bryant (1887) found only one more to name, the Guadalupe petrel. As Howell and Cade (1954) put it, the history of the avifauna is a sad one of reduction and extermination through destruction of habitat by goats, predation by house cats, and, regrettably, some excess of zeal by collectors. Apparently the Guadalupe rock wren, Guadalupe house finch, and Guadalupe junco are still doing well. For the latest update on the birds, see Jehl and Everett (1985). Hubbs and Jehl (1976) reported fossils of two birds from a Pleistocene deposit interpreted as of Sangamon Interglacial age.

Pilsbry (1927) recognized 14 species and subspecies of ground-living land snails for Guadalupe Island, eleven of them (79 percent) endemic. He found the fauna most closely related to that of the southern group of Channel Islands, with 8 species or subspecies occurring there also or having their closest relatives endemic there. Three others had nearest relatives in mainland California and two in northern peninsular Baja California. Most interesting is the genus *Binneya*, with two species, one endemic to Guadalupe and the other to Santa Barbara Island and northwest Baja California. As late as 1922 Hanna (1925) still found many land snails, but feral house mice have preyed on them until apparently, as he predicted, few are left.

Palmer and later naturalists collected various insects and spiders, some of which were reported by specialists: Arnaud (1959, 1963), Blaisdell (1925), Horn (1876), Scudder (1876). Snow (1899) listed collections from the fur seal trip of 1897. With the decline of the vegetation, presumably much of the original fauna is extinct. There is no comprehensive review evaluating the arthropod fauna, but González (1981) included a list of 90 species, compiled by Dr. Scott Miller, various of them still unidentified. About 18 are tentatively considered endemic.

Hubbs and Rechnitzer (1958) suggested that Guadalupe Island was proving to have a high degree of endemism in its littoral marine as well as its terrestrial biota, and they mentioned especially fishes. Briggs (1974) wrote that only about four shore fishes could still be considered well-defined endemics, others named from Guadalupe having since been found elsewhere. González (1981) included a list compiled by Dr. Richard Rosenblatt, of 125 shore fish species, including five endemics.

Strong and Hanna (1930) listed 87 marine molluscs from Guadalupe Island, mostly dredged from one area off the south end. They found this fauna very similar to the faunas of Catalina Island and the Coronado Islands and suggested that many had arrived on drifting kelp. Chace (1958) expanded the list to 193, still based on rather few collections. He found 149 (77.2 percent) belonging to the southern California fauna, 34 (17.6 percent) belonging to the Panamic fauna, and 10 (5.2 percent) endemic. Lindberg et al. (1980) reported a Pleistocene marine invertebrate fauna of 86 species, mainly molluscs, of Sangamon interglacial age.

Concerning the marine algae, Dawson (1960) remarked that isolated Guadalupe Island, unaffected by coastal upwelling, had an extremely interesting flora, with some Californian species, some tropical Mexican coastal species, some Indo-Pacific insular species, and a conspicuous group of endemics evidently derived from the Californian flora and showing

the effectiveness of isolation and divergent ecology on speciation. Stewart and Stewart (1984) summarized all records, listing 211 algal species, but mentioned other collections still unstudied.

The Vascular Plants

Native or Foreign?

In the beginning, of course, Guadalupe Island was a steaming pile of bare volcanic rock, with no native plants. All plants that grow there must be descendants of immigrants. So how early must one have come, and by what means, to qualify now as "native"? Perhaps seeming *most* native are those that have settled down and become endemic or perhaps survived there but died out elsewhere. In any case, the distinction is not so clear and obvious as it might at first appear. "Native" seems best defined a little vaguely as having arrived long ago without human help.

The most foreign Guadalupe plants, and in some ways the easiest to deal with in the flora if not in real life, are the 40 or so weeds that have come in the last two centuries, mostly from Europe. Table 1 lists them with sourceland and with yeardate of first record on the island; and in the Catalogue their names are starred. The table includes and notes those few seen only once or twice and apparently never well established.

So far so good, and this might be the best place to stop. A few floras treat all plants as equals, not saying whether they are native or foreign; and from some viewpoints, once the plant is there, it may not matter. But most floras tell what plants are supposed to be introduced, implying that the rest are native (and seeming to make the distinction with confidence)—but really leaving most in the category of *not supposed* to be introduced. In this flora I have tried to distinguish but have sometimes found it impossible. The endemic plants and some others are easily called native and the European weeds introduced, but other plants remain doubtful and debatable.

For such plants as *Oligomeris linifolia* and *Plantago ovata*, which grow also on other continents, there is some question whether they are even native to North America, let alone to the island. For North America, "native" generally means here before the Europeans. This makes a convenient if indefinite timeline, after which European plants have come in numbers but before which all is murky. But this vague definition may be hard to apply, as with *Oligomeris linifolia*. That grows also in the Old World and its relatives are all there, so clearly it came from there at some time: if that time was before the arrival of Europeans, we can call it "native" and if after, "introduced"; but who knows when it came? Furthermore, the Indians clearly moved some plants around before that arbitrary timeline, and of course some plants undoubtedly have since been moving about on their own, as they always have. So precisely where an American plant is "native" may not bear close scrutiny.

Those Guadalupe Island plants clearly native to western North America we are likely to take also as native to the island, but are they all? In fact, some authors have called certain ones introduced. In her "List of species widely distributed, probably introduced" on Guadalupe Island, Eastwood (1929:398) included, with no explanation, not only European weeds but also *Aristida adscensionis*, *Daucus pusillus*, *Juncus bufonius*, *Linaria canadensis*, *Muhlenbergia microsperma*, *Myosurus minimus*, *Parietaria "floridana"* (= *P. hespera*), *Phalaris "intermedia"* (= *P. caroliniana*), and *Silene antirrhina*. (She probably intended two separate lists.) Greene (1885:221, 223) thought *Eschscholzia californica*

TABLE 1. Introduced Plants of Guadalupe Island.

	Source	Found	Notes
Anagallis arvensis	Europe	1875	Not seen since 1885
Avena fatua	Europe	1875	Not seen since 1885
Avena sativa	Europe	1875	Not seen again
Brassica nigra	Europe	1875	Not seen again
Bromus tectorum	Europe	1875	Not seen again
Erodium cicutarium	Europe	1875	
Erodium moschatum	Europe	1875	
Galium aparine	Europe	1875	
Hordeum murinum ssp. *glaucum*	Europe	1875	
Malva parviflora	Europe	1875	
Silene gallica	Europe	1875	
Solanum americanum	S. America?	1875	
Sonchus oleraceus	Europe	1875	
Brassica rapa	Europe	1885	Not seen again
Bromus berteroanus	S. America	1885	
Bromus diandrus	Europe	1885	
Chenopodium murale	Europe	1885	
Mesembryanthemum crystallinum	Africa	1885	
Polypogon monspeliensis	Europe	1885	
Avena barbata	Europe	1889	
Centaurea melitensis	Europe	1889	
Melilotus indica	Europe	1889	
Sonchus tenerrimus	Europe	1889	
Vulpia bromoides	Europe	1889	Not seen again
Vulpia myuros var. *hirsuta*	Europe	1889	
Capsella bursa-pastoris	Europe	1897	
Lasthenia coronaria	Western N. America	1897	Not seen again
Hordeum murinum ssp. *leporinum*	Europe	1925?	
Hypochoeris glabra	Europe	1925	
Mesembryanthemum nodiflorum	Africa	1931	
Bromus rubens	Europe	1932	
Medicago polymorpha	Europe	1932	
Poa annua	Europe	1932	
Sisymbrium irio	Europe	1932	Reintroduced ca. 1988?
Bromus hordeaceus	Europe	1948	
Nicotiana glauca	S. America	1948	
Ruta chalepensis	Europe	1948	Doubtless planted
Cerastium glomeratum	Europe	1958	
Herniaria cinerea	Europe	1958	
Phalaris minor	Europe	1958	
Erodium brachycarpum	Europe	1978	
Lamarckia aurea	Europe	1983	
Raphanus sativus	Europe	1983	
Triticum aestivum	Europe	1983	Probably not persisting
Sisymbrium orientale	Europe	1988	

possibly and *Mentzelia micrantha* probably "of recent introduction." Vasey and Rose (1990:22) included *Suaeda "fruticosa"* (= *S. taxifolia*) among plants that "have very recently gained a foothold here." And Moran (1951:160) thought "*Oenothera micrantha*" (= *Camissonia robusta*) was likely a new arrival.

Without explanation, Brandegee (1900:22) called four west American plants introduced: "*Baeria coronaria*" (= *Lasthenia coronaria*), "*B. gracilis*" (= *L. californica*), "*Orthocarpus purpurascens*" (= *Castilleja exserta*), and *Platystemon californicus*. Palmer had found *L. californica* abundant and widespread 22 years before, and there is little reason to doubt that it is native in the present sense. The other three no one has found before or since, suggesting they might indeed have been waifs that never got well started; but without knowing Brandegee's thinking, it is hard to judge. Three more plants likewise have been found only once, and after the time of the first collectors: *Layia platyglossa* in 1897, *Stephanomeria diegensis* in 1906, and *Plagiobothrys acanthocarpus* in 1958.

Islands (and especially oceanic islands) are simpler to think about than mainland areas. But with some Old World islands, inhabited for centuries, distinctions between native and introduced must be greatly blurred, especially for weedy and useful plants, so that only the very latest arrivals can be recognized with confidence as foreign. Guadalupe, apparently never visited by Indians, might at first glance seem clear and easy by comparison. Even by 1875, however, when Palmer took the first plant records, it not only was losing natives to the goats but also had gained a dozen European weeds—noted for their almost magical abilities to arrive but usually needing some help. What else may have had help in arriving?

We may expect those west American plants that have achieved the high but nebulous status of nativehood on Guadalupe to have come only slowly, over the millenia, by various improbable means. Though a plant is unlikely to make its first *natural* arrival within any short time span, however, conceivably one can come at any time, like this week; on establishment, it will then automatically seem native so long as no one suspects it has just come. Of course a new arrival may get a slow start and may remain rare and local enough for several years to be overlooked by any collectors, so its arrival may not make the evening news. And what of *un*natural arrivals, meaning introductions with human help? Although sealers and goat hunters of earlier years may have brought little but weeds, we cannot know what they did bring. But what is more significant, the 1460 Angora goats reportedly brought from California in 1873 and 1874 (Esperanza 1874) could surely have carried in seeds of west American plants, and probably they did.

There is, in fact, good reason to question whether certain west American plants found on the island are indeed native. Some plants not found by early botanists undoubtedly were overlooked because they were rare or were local in remote parts of the island. But some that were not found then grow now where those early botanists camped and collected. Can these be long-established plants that have reached new areas on the island with the drastic changes wrought by the goats or for some other and unknown reason? Can some be annuals that appear only sporadically and thus happen to evade the unlikely visits of botanists to their home spot? Or can some perhaps be new arrivals?

For example, Greene found nine western plants in 1885 that Palmer had not noted in 1875, four of them near the springs where Palmer camped for some 15 weeks! Greene, and later Franceschi, found *Eschscholzia californica* in that general area but in one place only and away from the springs, where possibly Palmer had reason to miss it, unlikely though that may seem. Near the springs, however, Greene found a fine growth of *Filago californica* and fine large specimens of *Agoseris heterophylla*; so how could Palmer have missed these? Were they just not flowering that year? Or had the goats been hungrier? Greene raised no question about these two; but he was clearly perplexed that Palmer had failed to note *Dichelostemma pulchellum*, which was now exceedingly common all about the spring and on the slopes below — and large, with leaves three feet long and an inch wide. Could all four of these plants have failed to flower there the year of Palmer's visit?

On the other hand, remember, Greene did say that the eschscholzia might possibly be a recent introduction. Far from suggesting the same for the dichelostemma, however, he named it the next year as an insular new species (though that is not recognized today). So could all four of these plants have failed to flower there for Palmer? Perhaps they did not flower there that year because they just hadn't reached the island yet! The four give cumulative support to this idea.

How is it possible to tell whether western plants recently found on Guadalupe are native? Some clue might come from their distribution elsewhere, for example whether they grow on others of the islands and thus show an ability to reach islands. However, their means of reaching the other islands are as uncertain as their means of reaching Guadalupe: the islands of southern California have a long history of ranching, with goats, sheep, and cattle, which could have helped bring in foreign plants! And on the other hand, of course, they certainly helped destroy natives.

All together, a dozen or more plants remain doubtful and debatable. Very likely several of them are introduced, but which ones? Taking them as a group, the probability seems high that at least a few are recent arrivals; but taking them one at a time and without further evidence, the probability for any one is well below certainty. Having to start somewhere, and grasping for some solid basis, I assume that very few west American plants were brought in before the great influx of goats of 1873–74. I therefore tend to assume that west American plants collected by Palmer in 1875 are native — even though knowing some may not be. But what of those first found by Greene and later collectors? If they came from parts of the island where earlier botanists collected without finding them, then the later the date and thus the more botanists who had *not* found them, the greater the likelihood that they were recent arrivals. Surely some of those must be introduced, and I think probably most; but still, some may be native. In the Catalogue I discuss the status of each of these species, but always inconclusively. Since they can't either definitely be called native or definitely be called introduced, they must go into a separate category, of Possibly or Probably Introduced (Table 2). This is a satisfying solution to, or evasion of, a bothersome problem, though raising only slightly lesser questions of exactly which plants to include in this category and whether to call them *possibly* or *probably* introduced. In the discussion of different plants I use sometimes one word and sometimes the other.

Table 2 lists Greene's four additions plus eleven other plants found afterwards where earlier collectors had failed to find them. A clear example is *Camissonia robusta*, now common at Northeast Anchorage, where every early botanist went ashore without seeing it, but apparently first found in 1948. The table also includes two plants collected only by Brandegee in 1897, which he called introduced, though without saying why he thought so or where on the island he found them. In the Catalogue each of these 15 names is marked with a special symbol (ϕ) to show that the plant is in this uncertain category.

Not included in Table 2 are several other west American plants first found in recent years but seeming less likely new arrivals. For example, *Rhus integrifolia* is found only on Outer Islet, not visited by early collectors. *Antirrhinum watsonii* is widespread but not common at the south end, where either Palmer or Howell might have found it; but it could not have come with goats from California so must have found some other way, leaving no clue as to when. Likewise, *Cuscuta corymbosa* could not have come from California, and it grows where earlier botanists, except possibly Palmer, have not collected. For *Layia platyglossa* and *Stephanomeria diegoensis*, though first found in 1897 and 1906, there is no record of where on the island; and the collector of the one evidently, and of

TABLE 2. West American plants possibly or probably introduced on Guadalupe Island: found in later years where earlier collectors had failed to find them.

	Found	Notes
Agoseris heterophylla	1885	Found only once
Dichelostemma pulchellum	1885	Widespread and fairly common since
Eschscholzia californica	1885	Local, not seen since 1893
Filago californica	1885	Common ever since
Castilleja exserta	1897	Found only once
Platystemon californicus	1897	Found only once
Lupinus bicolor	1898	Now scarce or locally common
Atriplex californica	1931	Still found at one other place
Lepidium nitidum	1932	Since occasional
Plagiobothrys collinus var. *californicus*	1932	Scarce, or some years locally common
Spergularia marina	1932	Since occasional
Trifolium gracilentum	1932	Fairly common
Camissonia robusta	1948	Locally common since
Pectocarya linearis ssp. *ferocula*	1957	Fairly common since
Plagiobothrys acanthocarpus	1958	Apparently seen only that year

the other probably, reached places not visited earlier. Perhaps arbitrarily, I have placed *Lasthenia coronaria* with the introduced plants (Table 1) instead of with the possibly introduced because the evidence seems at least a little stronger.

GOATS AND PLANTS

No one knows when goats first reached Guadalupe Island (Fig. 23), but the earliest mention I have seen is by Xántus for 1859 (Madden 1949). As on so many islands, some ship, here perhaps a whaler or sealer, no doubt left a few goats to multiply into a fresh meat supply for later visits. Multiply they have. An estimate for 1870, perhaps far afield, placed their numbers at 100,000 or more, with a projected increase, if the current rate continued, to nearly 400,000 in 10 years (Esperanza 1874).

About that time, however, the goat population seems to have reached the carrying capacity of the island. Fragmentary notes by the first few naturalists show a disastrous decline of the vegetation around 1875 to 1892, suggesting that within that span the goats may have reached their greatest numbers or at least their greatest destructiveness. For example, in 1875 Palmer found junipers all over the "middle" of the island, but just ten years later Greene (1885) could find there only three that were not quite dead. And again, Greene described the northeast slopes as covered with sage scrub, dominated by *Senecio palmeri*; but four years later Palmer found many dead plants of the senecio and few still alive (Vasey and Rose 1890), and after only three more years Franceschi (1893c) found the slopes bare and the shrubs surviving only on cliffs, accessible only to winged creatures. These three reports, fortuitously spaced in a critical time, are a striking record of how goats destroyed the sage scrub in those seven years. The carrying capacity of the island must have declined abruptly then and must continue to decline as the island becomes more desertic.

Exploitation. When goats became abundant on the island, they were at various times harvested for hides and tallow as well as for meat, and apparently there was more than one attempt to improve the stock on the island. However, my information is fragmentary and almost haphazard. In early years, some Americans hunted goats without license from Mexico. In 1884 the Mexican government stationed 40 soldiers on the island to prevent

FIGURE 23. Feral goats above Northeast Anchorage, 25 April 1958.

their wholesale slaughter (Greene 1885, Agraz Garcia 1978); and goathunter Stewart (1965) told of losing 1200 skins in 1899 to a Mexican gunboat.

American hunters reportedly took thousands of hides in various years from the 1860s through the early 1900s, in one year as many as 30,000 (Esperanza 1874, Safford MS, Anthony 1925, Stewart 1965). Anthony (1925) wrote that as long ago as 1887, when he was first on the island, 15,000 hides were taken yearly with no noticeable effect on the herds. He said that many concessionaires failed at harvesting goats because the selling price for hides was too low — 75 each in 1899 according to Stewart. The Coast Pilot (U. S. Hydrographic Office 1951) mentioned that in 1930 there was a goat meat cannery at Northeast Anchorage, and in 1948 and later some remnants were still to be seen at the beach. Stewart (1965) gave a vivid account of the 1899 season, from April to late September, on the island with unlawful goat hunters.

Esperanza (1874) told how the California-based Guadalupe Island Company took control of the island in January 1873, planning to improve the strain of goats, and began to bring in Angora goats and to kill or castrate the wild bucks; but this venture failed. Without details, Agraz Garcia (1978) mentioned an introduction of English goats in 1909.

Agraz Garcia (1978) reported two government-sponsored expeditions to the island, apparently both in 1971, taking 20,800 goats and leaving, he said, 239. He did not say what 239 goats were spared, whether they were carefully selected to found a super-race or were just those that couldn't be caught. A concessionaire, with about 150 workers from southern Mexico divided between the two trips, spent 146 days rounding up goats and preparing the meat, bones, and hides. Meanwhile, Agraz Garcia studied the goats, and his report tells some of his observations. From an unexplained zoometric study, he thought

the goat population descended from four races: Orenburg, Kirghizian, "Pelo Rudo," and Nordska; thus he failed to detect the Angora race brought in a century before. With the goats gone or mostly gone, according to the plan, the Subsecretaria de Recursos Forestales y de la Fauna was to reforest the island but in fact did not. (That would have been the best thing possible had they first *completely* rid the island of goats!) Visiting West Anchorage and the airstrip in May of 1971, I saw what must have been the relics of the first of the two expeditions; and there was now a good road, newly built, from West Anchorage to the airstrip. Since many goats remained alive, the second expedition must have been still to come.

Agraz García did not even mention the operation of Pescados, Mariscos, y Carnes, S. A., in 1970, which I saw in progress in August. Starting about May, they built a runway at about 550 m elevation at the north base of El Picacho, built a rough jeep road about 16 km north to their camp in the cypress grove overlooking the spring, built corrals south of the spring, brought in a jeep and trailer in a C-47, and by August started flying out live goats to Ensenada. According to Oscar Paulin of COTECOCA in 1981, the 1970 operation took out 14,000 goats. Added to Agraz's figure, this would make some 34,800 goats in about one year. The next years must have been ideal for plants to recover and for botanists to work on the island.

Goats and the Flora. Plants of an oceanic island like Guadalupe have evolved in the absence of herbivores like goats, have developed no natural defenses against them, and so are particularly vulnerable to them — though some like the cholla (*Opuntia prolifera*) may have brought their defenses with them. Because annuals are abundant in spring and the goats can't eat them all, their very numbers allow some to make seeds to last over the dry season. Although the goats may gradually eliminate the rarer and more palatable, many annuals thus can live with goats. In the long dry season when the annuals are past, goats must still rely on their dried remains, but any perennials become relatively more vulnerable. In parts of the island most visited by goats, such as near the spring, no shrub within reach could withstand them; hence shrubs survive there only out of reach on cliffs.

The fact that any trees survive might suggest that trees are secure against goats, but cypresses still are dying from goats' eating their bark; and the record shows that vast numbers have died. In any case, as Anthony wrote, not even a pine, oak, or palm can look down on a seedling to replace the aged trees now falling; so in the long run, all trees will be gone. The pines and oaks are dying off most rapidly; but although many cypress and palms remain, their danger also is imminent.

Since goats are still eating bark from cypress trees and evidently killing some, we may wonder how any survive or why the effect is so different from place to place. I suppose the smaller eastern grove, now gone without a trace from the area around the springs, was more vulnerable to the goats just because they would be crowded there in dry summers. But it is hard to understand why in the greater part of the vast main cypress grove "only the fallen trunks, now far gone in decay" should remain in 1885, as described by Greene, whereas in other parts of that grove thousands still stand today (Fig. 25). Possibly there were other springs in that area: it is hard to imagine another cause.

Aside from the slaughter of goats by men, the goat population fluctuates with climatic cycles, decreasing in a series of dry years and recovering after wet. The plant cover fluctuates in the other direction: when goats are few, the plants increase. In average years many seedlings from cliff-dwelling plants like *Pentyle incana* appear on the slopes below but never reach maturity. When goats are few, the seedlings last longer, showing that

without goats the slopes would soon be covered; and no one knows what long-lost plants might reappear. In 1963–65, bad years for goats, *Lotus grandiflorus*, not seen by botanists since 1885, became common near the mouth of the arroyo at Northeast Anchorage, but by 1967 it was gone again, as if retreating back to some mountain refuge. At the same time two seedlings of *Lavatera occidentalis*, which on the main island can survive only on cliffs, got well started on the slopes and lasted a couple of years.

Distribution on the island. Goats generally prefer the northern and higher parts of the island, with better feed and more water. Some do reach even the extreme south end, a few even in dry summers, but these are only small numbers. In drier seasons, when plants are parched and the principal spring becomes the only source of fresh water, they cannot stay away from it for long. In the dry August of 1970 I found the herbage clipped off to the ground above about 800 m; and the goats had to go far downslope from the spring to forage and far to the south. Most goats looked weak and forlorn, and one even rolled over and died before my eyes: many more must have died that year before rains brought more feed. Again in August 1981, the upper slopes were bare beyond belief.

That goats prefer the north end is clear to see and is borne out by comparing the vegetation at the north and south ends. In the northern half of the island, aside from the poisonous weedy *Nicotiana glauca* and the vicious cholla, no shrubs survive except on cliffs; in the southern half, and especially at the low south end, some shrubs show little goat damage at low elevations but show more and more damage northward and upward, until they disappear at about 400 to 500 m. *Ambrosia camphorata*, for example, dominates some southern parts of the island but is rare and only on cliffs farther north. However, other shrubs that might grow at the south end but for the goats are lacking there. The goats that do go there doubtless change the vegetation by eliminating more palatable plants: plants found on the islets but not at the south end suggest what the goats must have eliminated on the main island. Northward, with more goats desperate in dry summers, the standard of palatability must become lower and lower and finally include almost all plants.

Now that people live at the south end of the island, probably fewer goats go there than before. At my first visit in 1948, in the second year of the weather station, only three people lived there, but it has gradually grown. At first, goat meat was an important item of diet, and a hunter went out every few days and later every week or so. Now, despite less hunting, I suppose the size of the base with its human activity must intimidate goats and must give some protection to the plants at the south end, or at least the southwest corner. In later years I thought I could see some change in the vegetation that might result from fewer goats, allowing some plants to re-colonize the main island from one of the islets. See, for example, *Castilleja fruticosa*, p. 150.

Effect on the island. Not only are goats extinguishing species of plants, but they also continue to destroy the vegetative cover of the island, even if not so rapidly as before. They may somewhat improve the soil with manure — some 300 kg each per year according to Agraz García (1978). However, their overgrazing prevents buildup of mulch and organic soil, leading to heating and drying of the soil and to rapid runoff of rainfall and so to soil erosion (Coblentz 1980). Also, their destruction of trees eliminates the fog drip that has added greatly to rainfall and so has helped feed the springs. Thus they have been changing the island from a "naturalist's paradise" to desert in a way that can never be completely reversed and corrected.

Hope for the future. Looking at the bare and degraded slopes of Guadalupe Island today,

it is hard to visualize the original cover of trees, shrubs, and herbs, and perhaps harder to believe that any return towards the pristine state is possible. But we can see some hope whenever a series of dry years lowers the goat population and the plants begin to recover, and especially when a long-lost plant reappears.

Hope can be seen also in the recent history of a few of the islands of southern California, such as San Clemente Island, 385 km (240 miles) north of Guadalupe. These islands were so devastated for two centuries by various combinations and sequences of cattle, sheep, pigs, goats, and rabbits, that many native plants were lost and replaced by European weeds, much of the soil was lost, and the original appearance is almost impossible to imagine. The sheep were removed from San Miguel Island in 1950 and burros more recently, so no herbivores remain; but trees and shrubs are gone and the soil is gone, according to Johnson (1980), from some two-thirds of the surface. On Santa Barbara Island, the rabbits were wiped out by 1981, so no herbivores remain. On Santa Catalina Island goats and pigs have been removed from some parts of the island and the removal continues. On the main part of Santa Cruz Island the Nature Conservancy has systematically removed herbivores, though that good work seems to have flagged in recent years (Junak et al. 1995). And on San Clemente under the U. S. Navy, biologists have made great progress in the last 20 years in removing goats and pigs, until all are gone, and in propagating and replanting native plants. In fact, the plants are now replanting themselves. However, European weeds also are thriving, not only competing with natives but also increasing the hazard of fire.

Ing. José Rico C. told me in 1994 that in recent years thousands of goats have been harvested on Guadalupe but that perhaps 7000 remained. If the goats are ever all removed, I am sure that many of the plants surviving on cliffs will spread on the slopes. Of course the many aggressive European weeds would also prosper and might tend to crowd out some natives. But with the removal of the goats, the process of desertification could slowly be reversed.

Because the goats have economic value, some may not want them totally removed, and there may be political pressure to keep the island as a goat range. There might then be pressure to introduce other pasture plants, as Agraz Garcia (1978) suggested, which would be a further calamity for the native flora. Even if the goats remain as a harvestable resource, however, important areas can still be protected from them by fences and to some degree will recover. If the cypress grove or some part of it were completely fenced, for example, with the goats outside, cypress seedlings could renew the grove, and many other native plants undoubtedly would reappear. A fence was started about 1981 but never finished. Fencing all the pines and palms would be harder because of the steep and rough terrain, but even smaller exclosures around some of these trees would allow them to reproduce locally. But they must be good fences: those built in 1987 to protect some of the pines, according to Libby (1990), the goats took only three months to breach! Also, exclosures would be extremely useful in other places, such as the lower valley below the cliffs of the Lower Circus: many rare plants on these cliffs, some now on the verge of extinction, might then seed themselves and survive. In fact, it is crucial to the ecology of the island, and even to the survival of the goats themselves, that fences be built and maintained, to rebuild the forest and to sustain and extend the springs.

The ideal, however, would be to remove all goats, as well as dogs, cats, and mice, and to preserve all the native plants, as Mexican ecologists have long urged (e.g. Ravest Santis 1983). In fact, Ing. José Rico C. tells me in 1994 that all concerned governmental agencies now agree on that objective. It is important to save even those plants not different enough

to have been named as endemics and important not to bring in other genotypes as replacements, even when identified as the same species. But it is particularly important to save the unique endemics. Some, like the pine, have great economic importance, but all have a scientific and even spiritual value because of their uniqueness. Preservation is urgent because the seed source and gene pool are shrinking, bringing more plants closer to extinction; and furthermore, the island is becoming more desertic and harder to restore. Guadalupe Island with its unique flora is a Mexican national treasure that urgently needs protection.

Past and Present Vegetation

Clearly the goats have profoundly affected the vegetation of Guadalupe Island. We have no account of the original vegetation but only fragmentary notes on how it appeared, already depleted, to the few early naturalists. The best early notes are by Greene (1885) and Franceschi (1893c), with some for individual species by Palmer (Watson 1876, Vasey and Rose 1890, McVaugh 1956, Safford MS). Also, ornithologist Walter Bryant (1887) and Dudley (1899) gave a few brief but helpful notes. At best there is little physical description of the vegetation but only a mention or description of species of trees and shrubs that clearly would be dominant, usually with no more than indirect hints as to associated plants. Likewise, of course, there is no full list of the original flora. Hence in telling of vegetation in different parts of the island, I am largely telling of species distributions.

As local climate varies from one part of the island to another, especially with altitude and exposure, the plants vary with it. The low south end of the island, with south exposure, is comparatively hot and dry and its plants desertic (Fig. 32) — though with frequent fogs there as elsewhere, lichens also are prominent, giving a yellowish cast to the scene. Weber (1994) in fact remarked that lichens often dominate the landscape and "form the principal vegetation of the island". The north slope of the island, being higher, with more cloud cover and fog, more rainfall and fog drip, and less direct sunlight than the south end, is comparatively cool and moist and has quite different vegetation, with many trees (Fig. 21). In fact, most Guadalupe trees now are in the higher northern third of the island. Although some plants grow almost throughout the island, most are more restricted, and some have been found only in one area or even only at one spot. Of course, present restriction may sometimes be due largely to destruction elsewhere by the goats or to desertification.

Trees. Much of the higher northern part of the island was originally covered with trees (Figs. 24, 25), but without human intervention the trees of the island seem doomed with the present generation. There are old trees and dead trees but no young ones, for no seedling escapes the goats. All the trees must be well past the century mark, and each season sees new windfalls. The scanty records show that many old trees over wide areas, at least cypresses and junipers, perished within a short time span, about when (or just before) the goats were doing their greatest damage to the sage scrub. At least two small trees, *Hesperelaea palmeri* and *Heteromeles arbutifolia* var. *macrocarpa*, are gone altogether.

Franceschi (1893a, 1893c) supposed that all the northwest part of the island had been clothed in dense pine forest (*Pinus radiata* var. *binata*), and he wrote that very large fires had evidently burned there more than once. The remaining pines are most crowded on the northeast ridge near North Point (Figs. 19–22) and only sparsely scattered on up the ridge and on the north slope among the palms. There is no record of associated shrubs;

FIGURE 24. The endemic Guadalupe Island palm (*Brahea edulis*) on the north slope of the island, 19 May 1971. Although the biggest palm grove is here, other palms grow in canyons scattered almost the length of the island.

FIGURE 25. Part of the large cypress grove (*Cupressus guadalupensis* ssp. *guadalupensis*) on the upper west slope of the island, looking southwest from Mt. Augusta, 13 February 1957. The grove stretches far around from the south (left) to the northwest, though most trees are now gone.

but *Ceanothus*, *Heteromeles*, and *Ribes*, come to mind as possible.

Franceschi (1893c) described the large palm grove (*Brahea edulis*) on the northwest slope of the island, where there are still hundreds or even thousands (Fig. 24). Palms also grow in canyons almost the length of the island, and at least a few grew scattered on the uplands, as west of the Northeast Oaks. I remember fewer dead ones than with the other trees, but they too must be dying of old age. Again there is no mention of associated shrubs.

Greene (1885) wrote that almost the entire plateau of the northern half of the island appeared to have been covered by cypress (*Cupressus guadalupensis* ssp. *guadalupensis*) but that in 1885 only fallen trunks remained over most of that area; the cause of the destruction he could not guess. Although the grove on the upper west slope of the island evidently is much reduced, remarkably, some thousands of trees still stand (Fig. 25), though their bark is often severely damaged by goats. Possibly their distance from the spring, the main source of water for goats in dry seasons, gives some slight protection. Bryant, Greene, and Franceschi all told of a smaller cypress grove on the plateau around the springs, on the eastern drainage, where in my time only a single dead tree still stood that now too is gone. Under the cypress of both the larger and smaller groves, Franceschi (1893c) found a few last survivors of what "must have [been] a thick and general underwood" 12 or 15 feet high of *Ceanothus crassifolius*; but these are all gone. The one shrub of *Arctostaphylos* sp. that Greene found under a cypress may have been another last survivor of that underwood.

Palmer in 1875 saw groves of juniper (*Juniperus californica*) in ravines and low valleys all over the "middle" of the island and occasional southward, but only ten years later Greene found nearly all dead. A few junipers have survived until recently on the southeast coast, where fewer goats range (Fig. 30), but at my last visit to that part of the island in 1970 they were under strong attack and many dead or dying.

Palmer found the oak (*Quercus tomentella*) frequent at the north end with the pines and occasional to the south in canyons on both sides of the island. At the north end a few still are scattered with the palms and more with the pines, and farther south also very few remain — probably not 50 now on the whole island (Figs. 26, 61, 62).

Scrub. By the earliest account, sage scrub covered the slopes in the northeast part of the island, dominated by the beautiful white endemic *Senecio palmeri* but also with abundant *Lotus argophyllus* ssp. *ornithopus*, *Sphaeralcea sulphurea*, *Calystegia macrostegia* ssp. *macrostegia*, and *Dichelostemma pulchellum* (this last probably introduced). Greene thus described the northeast slope in 1885, but already the goats were rapidly destroying everything in reach. Less than eight years later Franceschi found the slopes bare and the shrubs surviving only on cliffs. Because Palmer in 1875 found several plants rare on cliffs that probably grew before on the slopes, including some never seen again, still others may originally have been part of the scrub. Possible examples are: *Coreopsis gigantea*, *Crossosoma californicum*, *Daucus pusillus*, *Eriogonum zapatoense*, *Euphorbia misera*, *Galvezia speciosa*, *Haplopappus canus*, *Lavatera occidentalis*, *Malosma laurina*, *Perityle incana*, *Phacelia phyllomanica*, *Rhamnus pirifolia*, *Rhus integrifolia*, *Scrophularia villosa*, *Solanum wallacei* ssp. *clokeyi*, and *Stephanomeria guadalupensis*.

Most of this northern upland once covered with scrub is now reduced to goat pasture (Fig. 27), with mostly annuals. Predominant are European weeds, especially *Erodium cicutarium*, *E. moschatum*, and *Hordeum murinum*, but also commonly *Avena barbata*, *Bromus diandrus*, *B. rubens*, *Malva parviflora*, *Silene gallica*, *Sonchus oleraceus*, and

FIGURE 26. Small grove of island oak (*Quercus tomentella*) in hanging tributary of Esparsa Canyon at 450 m, east of Mt. Augusta; 2 May 1967.

Vulpia myuros var. *hirsuta*. However, some native annuals also are often common, like *Calandrinia ciliata*, *Claytonia perfoliata* ssp. *mexicana*, *Crassula connata*, *Cryptantha foliosa*, *Filago californica* (probably introduced), *Gilia nevinii*, *Parietaria hespera* var. *hespera*, and *Pterostegia drymarioides*. Less general but common locally in good years are such annuals as *Amsinckia menziesii*, *Lepidum lasiocarpum* var. *latifolium*, *L. oblongum* var. *insulare*, *Linanthus pygmaeus* ssp. *pygmaeus*, *Pholistoma racemosum*, and *Trifolium palmeri*.

In northern parts of the island the native shrubs now survive only on cliffs, beyond the reach of goats and sometimes of botanists as well. Some like *Galvezia speciosa* and the endemic *Perityle incana* (Figs. 28, 51), which are abundant and reproducing well, clearly are natural cliffdwellers and have a secure future. But those that were rare on cliffs before have now only become rarer: *Malosma laurina* has only three or four survivors, all very old shrubs that may even date back to before the goats (Fig. 29). There must have been many on the slopes before, making millions of seeds and multiplying into probability the chance of a rare start on a less suitable place like a cliff. But now that so few remain, making few seeds, the chance of starting in such a place is much smaller. So the number of such shrubs is likely to dwindle until the species dies out on the island; and from the old records, it has been dwindling. Other shrubs rare on northern cliffs, and one or two perhaps extinct since my first visits, include *Ambrosia camphorata* (common at south end), *Artemisia californica*, *Crossosoma californicum*, *Euphorbia misera* (common on Outer Islet), *Galium angulosum*, *Haplopappus canus*, *Lavatera occidentalis* (common on Outer Islet), *Phacelia phyllomanica*, *Rhamnus pirifolia*, *Scrophularia villosa*, and *Senecio palmeri*. Other shrubs or subshrubs that are more common on the cliffs and are likely to

FIGURE 27. Guadalupe upland formerly covered with shrubs but now reduced to goat pasture, with mainly European weeds though with some native annuals; 17 December 1957. In the northern half of the island, shrubs survive only on cliffs, beyond the reach of goats.

FIGURE 28. The endemic *Perityle incana* on cliff of the Lower Circus, 27 January 1960. It is common on cliffs, a natural cliffdweller with a secure future.

FIGURES 29 and 30. Shrubs not at home on cliffs are rare, becoming rarer, dying out in the northern half of the island. FIGURE 29. Laurel sumac or lentisco (*Malosma laurina*) on cliff of the Lower Circus, 29 June 1968. Only three or four are left on the island. FIGURE 30. Juniper (*Juniperus californica*, *M12062*) about 4 m high and 8 m wide hanging from cliff, at 350 m on lower east slope of El Picacho, 4 March 1965. Juniper is nearly extinct on the island

survive are *Calystegia macrostegia* ssp. *macrostegia*, *Hemizonia frutescens* (north end), *Sphaeralcea sulphurea*, and *Stephanomeria guadalupensis*, as well as some herbaceous plants.

For the north slope there is no early description of the vegetation aside from the trees. Possibly common on the north slope was *Hemizonia frutescens*, now common there on cliffs. The lower vegetation now is largely annuals, in spring more lush there than in drier areas to the south. These include such weeds as *Capsella bursa-pastoris*, *Cerastium glomeratum*, *Erodium cicutarium*, *E. moschatum*, *Galium aparine*, *Hordeum murinum*, *Hypochoeris glabra*, *Malva parviflora*, and *Silene gallica*. Native annuals that are mostly towards the north end include *Aphanes occidentalis*, *Githopsis diffusa* var. *guadalupensis* (rare), *Myosurus minimus* var. *filiformis* (rare), *Ranunculus hebecarpus*, and *Stellaria nitens* (northeast slope to cypress grove). On cliffs at the north end are *Hemizonia frutescens*, *Poa secunda* ssp. *secunda* (rare), *Polypodium scouleri* (rare), and *Polystichum munitum* (rare); also *Baeriopsis guadalupensis*, *Eschscholzia palmeri*, and *Lomatium insulare*, which are also at the south end and on the islets. Especially on shaded cliffs and some in talus at the bases of cliffs, there and southward, are *Cheilanthes newberryi*, *Dudleya virens* ssp. *extima*, *Jepsonia malvifolia*, *Pentagramma triangularis*, *Polypodium californicum*, and *Triteleia guadalupensis*, none of them very common.

Farther south, near the "middle" of the island, the three characteristic shrubs, according to Palmer, were the abundant *Ambrosia camphorata*, "giving the country a greenish white appearance"; *Atriplex barclayana*, "scarcely half so abundant"; and *Artemisia californica*, less frequent but still "giving character to the vegetation" (Watson 1876). Below 500 m in the southern half of the island the ambrosia is still abundant over wide areas, on the top and on the southeast slope of the island, still coloring the landscape; and the atriplex is still abundant in other places on top and on the south end mesa (Fig. 32). The artemisia is gone except possibly for a few survivors on northern cliffs. Herbaceous plants common in the southern half of the island include *Amblyopappus pusillus*, *Aphanisma blitoides*, *Oligomeris linifolia*, *Parietaria hespera* var. *hespera*, *Plantago ovata*, and *Pterostegia drymarioides*, and common more locally *Calandrinia maritima*, *Crassula connata*, *Cryptantha foliosa*, *C. maritima*, *Eschscholzia palmeri* (flowering first year), *Lupinus niveus*, *Perityle emoryi*, *Sphaeralcea palmeri*, and *Trifolium palmeri*. Common weeds include *Erodium moschatum*, *Hordeum murinum*, *Mesembryanthemum crystallinum*, *M. nodiflorum*, and *Sonchus oleraceus*.

For the far south end we have no description of the original vegetation beyond a first list of the plants, for 1889. However, the vegetation of the islets, undisturbed by goats, gives some clues (Figs. 34, 35). At the south end, with the more palatable plants doubtless eliminated, several shrubs and subshrubs still remain common, notably *Atriplex barclayana* (Fig. 32), *Hemizonia greeneana* ssp. *greeneana* (Figs. 33, 50), *H. palmeri* (Plate 1D), *Lycium californicum*, *Mirabilis californica*, and *Sphaeralcea palmeri* (Figs. 31, 69). Such plants as *Castilleja fruticosa* and *Lomatium insulare* (Figs. 31, 77), now found near the west end of the mesa above Campo Sur, may be new colonists from the islets, given some protection by the nearness of the village. Likewise, *Baeriopsis guadalupensis*, now seen on the steep north slope below the road where it climbs onto the mesa, may have increased with protection.

The Islets. The offshore islets are a small but fascinating and invaluable sample of southern Guadalupe Island undisturbed. They are of great botanical interest because their vegetation must show much how the original south-end vegetation looked before the goats. They are refugia where rare plants survive, some perhaps to return someday to the main island.

FIGURES 31 and 32. At the dry south end, where few goats range so far from water, perennials and even shrubs survive, even within reach; 18 December 1957. FIGURE 31. Rocky south-end mesa just above Campo Sur, with *Lomatium insulare*, *Atriplex barclayana*, and *Sphaeralcea palmeri*. FIGURE 32. Sparse low cover of *Atriplex barclayana* on the south-end mesa; looking south towards South Bluff.

FIGURE 33. Sparse growth of *Hemizonia greeneana* ssp. *greeneana* (with *Atriplex barclayana)* on a cinder cone at the south end, 20 August 1970.

Islote Negro. Islote Negro (Fig. 15) is small and rather barren, with few habitats and a small flora. I found only 27 species of vascular plants:

Amblyopappus pusillus
Antirrhinum watsonii
Aphanisma blitoides
Atriplex barclayana
Baeriopsis guadalupensis (Guadalupe endemic)
**Chenopodium murale*
Cistanthe guadalupensis (Guadalupe endemic)
Cryptantha maritima
Dudleya guadalupensis (Guadalupe endemic)
Eschscholzia palmeri (Guadalupe endemic)
Galvezia speciosa (Insular endemic)
Hemizonia greeneana ssp. *greeneana* (Guadalupe endemic)
Lycium californicum
Mammillaria blossfeldiana var. *shurliana*
**Mesembryanthemum crystallinum*
**Mesembryanthemum nodiflorum*
Mirabilis californica
Oligomeris linifolia
Parietaria hespera var. *hespera*
Perityle emoryi
Perityle incana (Guadalupe endemic)
Phacelia floribunda (Insular endemic)

FIGURES 34 and 35. Vegetation of Outer Islet, undisturbed and much as vegetation must have looked at the south end of the main island before the goats; 21 June 1968. FIGURE 34. Floor of the crater, with *Cistanthe guadalupensis* (thick stems, leafless in summer), *Lycium californi-cum*. FIGURE 35. Shallow upper valley at 190 m, looking north to the main island, with *Lavatera lindsayi* (right foreground), *Stephanomeria guadalupensis* (white), *Atriplex barclayana*, *Coreopsis gigantea*.

Plantago ovata
**Sonchus oleraceus*
Spergularia macrotheca
Sphaeralcea palmeri (Guadalupe endemic)
Trifolium palmeri (Insular endemic)

All are Dicots. Four (marked with *) are Old World annual weeds, though of these only *Mesembryanthemum crystallinum* is common. Seven are Guadalupe Island endemics, and three more are insular endemics, found only on Guadalupe and others of the islands but not on the mainland. Various of these plants are common at the south end of the main island, such as *Amblyopappus pusillus*, *Lycium californicum*, *Mirabilis californica*, *Parietaria hespera* var. *hespera*, and the endemic *Hemizonia greeneana* ssp. *greeneana* and *Sphaeralcea palmeri* (Fig. 69). But Islote Negro is strikingly different from even nearby and closely comparable areas on the main island because common here, even in flat places, are plants rare on the main island except on cliffs. *Perityle incana* and *Galvezia speciosa*, both common here, are found on the main island mainly in the northern part, where they grow only on cliffs (Figs. 28, 51). *Mammillaria blossfeldiana* var. *shurliana*, though widespread at low elevations on the main island, is nowhere common there but is abundant here (Plate 1A). *Baeriopsis guadalupensis* (Fig. 47), scarcely to be found on the main island at all, also is abundant here. Likewise, *Cistanthe guadalupensis*, seldom seen on the main island except rarely on seacliffs, is abundant and luxuriant here (FRONTISPIECE, Figs. 73, 74). *Dudleya guadalupensis* has never been found on the main island but is common on the islets (Figs. 57, 58).

Outer Islet. Like Islote Negro, Outer Islet is a remarkable and revealing sample of south-end Guadalupe Island undisturbed; but this islet is larger and farther offshore (Fig. 17), and its flora is larger and truly unique. My four visits to Outer Islet, one overnight but all of them too short, stand out as highlights in my botanical memories. I found 38 species of vascular plants:

Aphanisma blitoides
Atriplex barclayana
Atriplex californica
Baeriopsis guadalupensis (Guadalupe endemic)
Calystegia macrostegia ssp. *macrostegia* (Insular endemic)
Castilleja fruticosa (Guadalupe endemic)
Cistanthe guadalupensis (Guadalupe endemic)
Coreopsis gigantea
Crassula connata
Crossosoma californicum (Insular endemic)
Cryptantha foliosa (Guadalupe endemic)
Descurainea pinnata ssp. *menziesii*
Dichelostemma pulchellum
Dudleya guadalupensis (Guadalupe endemic, islets only)
Eriogonum zapatoense (Guadalupe endemic, Outer Islet only)
Erysimum moranii (Guadalupe endemic, Outer Islet only)
Eschscholzia palmeri (Guadalupe endemic)
Euphorbia misera
Galvezia speciosa (Insular endemic)
Hemizonia greeneana ssp. *greeneana* (Guadalupe endemic)
Hutchinsia procumbens

Lavatera lindsayi (Guadalupe endemic, islets only)
Lavatera occidentalis (Insular endemic)
Lomatium insulare (Insular endemic)
Lotus argophyllus ssp. *ornithopus* (Insular endemic)
Lycium californicum
Mammillaria blossfeldiana var. shurliana
**Mesembryanthemum crystallinum*
Mirabilis californica
Oligomeris linifolia
Parietaria hespera var. *hespera*
Perityle emoryi
Perityle incana (Guadalupe endemic)
Phacelia floribunda (Insular endemic)
Pholistoma racemosum
Rhus integrifolia (Not on main island, but on mainland)
Spergularia macrotheca
Sphaeralcea palmeri (Guadalupe endemic)

All but one are Dicots and all but one native. Ten are native annuals, all but two of these common on the main island. Twelve are Guadalupe Island endemics, and seven more are insular endemics. Here again *Baeriopsis guadalupensis*, *Cistanthe guadalupensis* (Fig. 34), *Galvezia speciosa*, and *Perityle incana*, are common and not confined to cliffs. Common too are the endemic *Castilleja fruticosa* and *Hemizonia greeneana* ssp. *greeneana*, otherwise local but common at the south end of the main island, and the insular *Lomatium insulare*, local at the south end and on the northwestern cliffs. Also common are *Euphorbia misera* and the endemic *Stephanomeria guadalupensis* (Figs. 53–55), uncommon on the main island and largely confined there to cliffs, and the insular *Lavatera occidentalis* (Figs. 67, 68), rare on the main island, on northern cliffs. The insular *Crossosoma californicum*, rare on northern cliffs is rare here too: I saw only one shrub and only on my first visit. Lastly, common here, and at least visible on Inner Islet and perhaps common on top, is *Coreopsis gigantea* (Fig. 48), not seen on the main island since Palmer found two plants in the crevices of high rocks in 1875.

Finally, Outer Islet has five plants (marked "islets only" or "Outer Islet only") never found on the main island: *Rhus integrifolia* (Fig. 48), also widespread on the mainland, and the four Guadalupe Island endemics *Dudleya guadalupensis* (also on Islote Negro and Middle Rock), *Eriogonum zapatoense* (Fig. 72), *Erysimum moranii*, and *Lavatera lindsayi* (also on Middle Rock) (Figs. 65, 66). Although no one ever saw these five on the main island, they must have grown there, like the coreopsis, until wiped out by goats. The five species make up over 13 percent of the small native flora of the islet. This is the only faint suggestion we have of how many plants, and how many endemics, the goats must have destroyed on Guadalupe Island before any one could see them. That is a lesson of the islets.

Extinct Plants and Nearly Extinct

By the time Dr. Palmer landed on Guadalupe Island in 1875, the goats had made serious inroads and many plants that might have grown on slopes were found only on cliffs; and eight that he found have not been seen again. Also, many aggressive foreign weeds were crowding native plants, perhaps contributing to their extinction. However, weeds are few in some habitats, as on volcanic cliffs, and there are few on the islets.

Of some 156 native, and some doubtfully native, plants of Guadalupe Island, 26 have not been found since about 1900 (Table 3). Most of these almost certainly are extinct on the island, though for some it is hard to be sure. Though considering in the Catalogue the likelihood of survival for each, and still cherishing hope for a few, I mark each with a dagger (†) in the Catalogue and officially list them all in Table 3 as probably extinct. As shown in Table 1, eight of the weeds likewise have not been seen since 1900 and probably are extinct, apparently never having gotten well started.

TABLE 3. Native or possibly native plants probably extinct on Guadalupe Island: mostly not seen since 1900.

	Last Seen	Notes
Ceanothus cuneatus	1875	Only three, nearly dead
Dissanthelium californicum	1875	Found once each on Santa Catalina, Guadalupe, and San Clemente Islands
Hesperelaea palmeri	1875	Only three still living then; endemic
Micropus californicus	1875	
Planta species	1875	Only two, sterile; doubtless endemic
Pogogyne tenuiflora	1875	"Very rare" (only one?); endemic
Ribes sanguineum	1875	Only two
Silene antirrhina	1875	Occurring sparingly
Agoseris heterophylla	1885	Only collection; introduced?
Allophyllum gilioides	1885	Abundant in 1875
Arctostaphylos sp.	1885	Only collection, only one seedling
Epilobium foliosum	1885	First in 1875; few in 1885
Malacothrix clevelandii	1885	Abundant in 1875
Phoradendron densum	1885	First in 1875
Satureja palmeri	1885	Abundant in 1875; endemic
Ceanothus crassifolius	1893	First in 1875; mostly dead in 1893
Eriophyllum lanatum var. *grandiflorum*	1893	First in 1875; rare then
Eschscholzia californica	1893	First in 1885; one place only; probably introduced
Hesperocnide tenella	1893	First in 1875; "very common everywhere" in 1893
Castilleja exserta	1897	Only collection; doubtfully native
Layia platyglossa	1897	Only collections
Platystemon californicus	1897	Only collection; doubtfully native
Castilleja guadalupensis	1898	Rare in 1875; endemic
Nicotiana attenuata (*N. petuniaeflora*)	1898	First in 1875, in a few places
Stephanomeria diegensis	1906	Only collection
Heteromeles arbutifolia var. *macrocarpa*	1958	First in 1957; only one tree

Many other plants are now rare and threatened with extinction — or some of them perhaps already gone. All trees are threatened, though we may hope that help will come before too late. Also threatened are seven shrubs that survive only on northern cliffs and that aren't known to be reproducing: *Artemisia californica*, *Crossosoma californicum*, *Galium angulosum*, *Haplopappus canus*, *Malosma laurina*, *Rhamnus pirifolia*, and *Scrophularia villosa*. Were it not also on Outer Islet, *Lavatera occidentalis* would also be on this list; but otherwise-rare plants that grow in good numbers on the islets seem safe enough for the present. Plants that I have seen only rarely or not at all and that seem most threatened,

some of which may be gone by now, include: *Camissonia guadalupensis* ssp. *guadalupensis*, *Descurainia pinnata* ssp. *menziesii*, *Githopsis diffusa* var. *guadalupensis*, *Myosurus minimus* var. *filiformis*, *Matricaria matricarioides*, and *Plagiobothrys acanthocarpus*. Others that, so far as known, are rare or very local include *Atriplex californica*, *Castilleja attenuata*, *Chamaesyce pondii*, *Cistanthe maritima*, *Cuscuta corymbosa*, *Daucus pusillus*, *Gnaphalium stramineum*, *Hutchinsia procumbens*, *Lotus grandiflorus*, *Melica imperfecta*, *Mimulus latifolius*, *Phacelia phyllomanica*, *Poa secunda* ssp. *secunda*, *Polystichum munitum*, *Senecio palmeri*, *Solanum wallacei* ssp. *clokeyi*, *Stipa lepida*, *Thysanocarpus erectus*. Others that are scarcely more widespread include *Dodecatheon clevelandii* ssp. *insularis*, *Gnaphalium bicolor*, *Harpagonella palmeri*, *Linaria canadensis*, *Lupinus guadalupensis*, *Lycium fremontii*, *Solanum douglasii*, and *Stebbinsoseris heterocarpa*.

Many cliffs on the island are inaccessible and unexplored and may still harbor plants not seen for many years or even some never found. In crowded days ashore while working from a ship, there was too little time to reach some of these cliffs and work them thoroughly. Now that there are roads and permanent camps on the island, a botanist based on shore and having time and transportation might find it rewarding to work some of them more thoroughly. On my first dozen trips to the island, the list of perhaps-extinct species was cut down almost every trip.

Although some cliffs can be scanned at short range from below, others cannot be. The often fog-drenched sheer cliffs at the north end of the island seem an especially likely place for some rare plants to persist, and in fact they have yielded a few to some rather precarious fishing from above. With time and patience these and other cliffs could profitably be explored further, even if never completely. There are, for example, very promising cliffs at the brink northwest of Mt. Augusta and others on the southwest coast, and in both places it is not too hard or too hazardous to go partway down from the top and then work upward. In some places two or more people could use ropes and other climbing aids to advantage. Travelling alone, I found good use for a tree trimmer with a 24-foot aluminum pole in six four-foot sections — though this often seemed just too short, and I would recommend another 7½ inches.

The top of Inner Islet always seemed to me the most interesting but unattainable objective.

Composition and Relationships of the Flora

Rzedowski (1978, fig. 65) recognized 17 floristic provinces for Mexico, including a "Provincia de California," nearly equivalent to the California Floristic Province, which extends into northwest Baja California, and a "Provincia de Baja California," for the rest of the peninsula. However, he made Guadalupe Island a separate "Provincia de la Isla Guadalupe," mentioning the relationship to the flora of Alta California and especially to that of the islands off the coast but stressing the degree of endemism.

No flora is complete without a neat summary of how many plants of each major group are native and how many introduced, where else they grow, and, especially with an island flora, what percentage are endemic. Raven (1963, 1967) discussed thoroughly and in detail the floristics of the California islands plus Guadalupe. There is little to add except for changes in numbers with newer information. Wallace (1985) checked herbarium records and made a very useful summary of these island floras, which gave us new numbers, as the present flora does for Guadalupe Island. Notably, a reconsideration of what plants are native to Guadalupe slightly reduces the size of the accepted native flora.

The total known vascular flora of Guadalupe Island is 216 species (and subspecies and

varieties), including plants that once grew on the island but are now extinct there. These include some weeds that may have grown there only briefly and never become well established. It does not include the various species discussed under Doubtful and Excluded Species (p. 168)

All together, then, 216 species of seed plants and ferns have been found on Guadalupe Island — but not all at one time. Thirty or more species that once grew there are extinct on the island (Table 3; also Table 1). Meanwhile, as if to fill the void, new weeds keep coming. Of the 216 listed species, about 45 are relative newcomers and mostly weeds, mostly from Europe (Table 1); and 15 west American plants not found by the first collectors also are probably or possibly introduced (Table 2). Thus under a strict yet somewhat hazy definition, only 156 species remain listed as native plants.

There is no knowing how many species were destroyed by goats before they could be found by botanists, so the size of the Guadalupe flora before goats is unknown. However, the number surviving only on goatless islets is suggestive: of the small flora of Outer Islet, 13 percent (five species) appear to be extinct on the main island. Assuming as a rough estimate that 13 percent of the Guadalupe flora went extinct without being found, the flora before goats would be 179 species.

For each of the eight Channel Islands plus Guadalupe and Cedros, Raven (1967) discussed the size of the native vascular flora in relation to the size of the island. He concluded that in the Channel Islands group an island the size of Guadalupe might have a flora of over 400 species. The much smaller size of the actual Guadalupe flora may be related to the greater distance of the island from the mainland, perhaps making it harder for immigration to keep up with extinction. Since the size of the Guadalupe flora more closely approaches that of Cedros, a somewhat larger island close to the mainland but at about the same latitude, the small size of the Guadalupe flora may be related also to ecological differences of these islands from the Channel Islands much farther north, such as drier climate (Moran 1967).

Of the 156 native plants, 34 species and subspecies, making 21.8 percent of the native flora, are endemic to Guadalupe Island. Two of these species belong to monotypic genera, *Baeriopsis* J. T. Howell and *Hesperelaea* A. Gray, which thus are endemic genera. The unidentified sterile plant (*Planta* sp.) of Palmer's collection, which several keen botanists failed to recognize even to family, was surely an endemic species and possibly would be another endemic genus. Also, *Nesothamnus* Rydb. (for *Perityle incana*) is a very distinct endemic, standing well apart from other species placed in *Perityle*; and it could arguably be kept as an endemic genus, as did J. T. Howell (1942). And finally, E. L. Greene proposed for *Eschscholzia palmeri* (and his *P. frutescens*) an endemic genus *Petromecon*, which Fedde (1909, 1936) in his world monographs of the family also kept but later students of the family have not. We can't even guess how many endemics were already extinct by Palmer's day. The endemics are as follows († = extinct):

Baeriopsis guadalupensis
Brahea edulis
Camissonia guadalupensis ssp. *guadalupensis*
Castilleja fruticosa
†*Castilleja guadalupensis*
Cistanthe guadalupensis
Cryptantha foliosa
Cupressus guadalupensis ssp. *guadalupensis*

Dudleya guadalupensis
Dudleya virens ssp. *extima*
Eriogonum zapatoense
Erysimum moranii
Eschscholzia elegans
Eschscholzia palmeri
Galium angulosum
Githopsis diffusa var. *guadalupensis*
Hemizonia frutescens
Hemizonia greeneana ssp. *greeneana*
Hemizonia palmeri
†*Hesperelaea palmeri*
Lavatera lindsayi
Lupinus niveus
Marah guadalupensis ?
Perityle incana
Phacelia phyllomanica
Pinus radiata var. *binata*
†*Planta* sp.
†*Pogogyne tenuiflora*
†*Satureja palmeri*
Senecio palmeri
Sphaeralacea palmeri
Sphaeralcea sulphurea
Stephanomeria guadalupensis
Triteleia guadalupensis

The other 122 native plants, of course, are wider ranging, or non-endemic. Of these only eight species, or 5 percent of the native flora, grow on the peninsula of Baja California and sometimes beyond but not north into Alta California. These are mainly desert plants and grow mostly at the desertic south end of the island. They are:

Ambrosia camphorata
Antirrhinum watsonii
Atriplex barclayana
Chamaesyce pondii
Cuscuta corymbosa
Lepidium lasiocarpum var. *latifolium*
Mammillaria blossfeldiana var. *shurliana*
Thysanocarpus erectus

Thus the majority of the non-endemic plants, some 114 species or 73.1 percent of the native flora, grow also to the north, in Alta California, and especially on the Channel Islands off southern California. In fact, 101 of them, or nearly 65 percent of the native flora, grow also on some of those islands and (a few) on islands off northwest Baja California. It may be noted that winds and currents reaching Guadalupe are prevailingly from the north and northwest, and seeds are perhaps most likely to reach Guadalupe from this direction; and these other islands of course have a somewhat similar maritime or insular climate. In fact, 19 plants, or 12.2 percent of the native flora, are *insular endemics*, growing also on one or more of the islands off southern California and northwest Baja California but not on the mainland. They are as follows (the other islands being AN,

Anacapa; BA, Santa Barbara; Ben, San Benitos; CA, Santa Catalina; Ced, Cedros; CL, San Clemente; Cor, Coronados; CR, Santa Cruz; Mar, San Martin; MI, San Miguel; Nat, Natividad; NI, San Nicolas; RO, Santa Rosa; SPH, San Pedro Hill; Tod, Todos Santos — see Fig. 1):

Calystegia macrostegia ssp. *macrostegia* AN, CA, CR, Mar, MI, RO, SM
Crossosoma californica CA, CL, SPH
†*Dissanthelium californicum* CA, CL
Eschscholzia ramosa BA, Ben, CA, Ced, CL, Cor, CR, Mar, Nat, NI, RO, Tod
Galvezia speciosa BA?, CA, CL
Gilia nevinii AN, BA, CA, CL, CR, NI, RO
Haplopappus canus CL
Jepsonia malvifolia CA, CL, CR, NI, RO
Lavatera occidentalis Cor
Linanthus pygmaeus ssp. *pygmaeus* CL
Lomatium insulare CL, NI
Lupinus guadalupensis CL
Mimulus latifolius CR
Phacelia floribunda CL
Quercus tomentella AN, CA, CL, CR, RO
Rhamnus pirifolia CA, CL, CR, MI, RO
Scrophularia villosa CA, CL, RO
Solanum wallacei ssp. *clokeyi* CR
Trifolium palmeri BA, CA, CL, NI

Of the Guadalupe endemics, six have their closest relatives on other islands: *Camissonia guadalupensis* ssp. *guadalupensis*, *Dudleya virens* ssp. *extima*, *Eriogonum zapatoense*, *Haplopappus canus*, *Lavatera lindsayi*, and *Solanum wallacei* ssp. *clokeyi*.

Clearly, the relationship of the flora of Guadalupe Island is mainly to the north, with the flora of Alta California and especially the flora of its islands. Therefore, as Raven and Axelrod (1978) explained, and indeed as Howell (1931) had shown in slightly different terms before, Guadalupe Island can fairly be called a southern outlier of the California Floristic Province.

Plant Collectors

My aim here is to tell about the plant collectors, especially the early ones, and their trips to the island: what is known or can be deduced about where they collected, what new plants they found, where their collections are reported, where the specimens are filed, and any sources of pertinent information — in short, to bring together any facts that will help interpret their collections. Herbarium abbreviations follow Holmgren et al. (1990). Nelson (1921:140–147) concisely summarized scientific explorations in Baja California up to 1911, including the work of most early collectors considered here.

In those early days when Guadalupe Island was remote, wild, and unknown, every naturalist visit was both a major undertaking and a botanical landmark. As the world has shrunk, visits have become easier and more frequent. And the island itself has changed, less now because of the goats: with colonists and even roads, it is no longer the wild place I first knew in 1948, even as that was no longer the more nearly pristine island Xántus saw but failed to describe in 1859. With the coming of cruise ships, when almost anyone can become a world traveler for a week, it is impossible to keep track of everyone who might

have brought back a few plants — and perhaps not worth trying.

JANOS XANTUS. Although the record of *collectors* rightly begins with Edward Palmer, it is not quite complete without mention of János (or John) Xántus de Vesey, credited by Madden (1949:104) with "the first recorded scientific exploration of Guadalupe Island". Xántus made important early natural history collections in California and Baja California; but at the same time he was becoming a sort of Baron Munchausen of his native Hungary by writing extravagant tales of imaginary exploits in the American West, with text and illustrations largely lifted from U. S. Government reports of the military explorers (Madden 1949, 1977; Zwinger 1986). In a letter from Xántus to Secretary Spencer Baird of the Smithsonian Institution, quoted by both Madden and Zwinger, he tells of going ashore on Guadalupe Island for several hours on March 17, 1859. Although his time ashore was short, we could wish for collections from that time 16 years before Edward Palmer's first visit; but Xántus mentioned none and apparently made none. Or at least we might hope for a naturalist's description of the island of that day before the goats peaked (he did mention about 10,000 goats); but he wrote, for example, that it was "covered entirely with gigantic cactacea of innumerable genera & species," with specific mention of *Cereus giganteus*, where others have found but two small cacti. He also mentioned "a dark colored *Lepus*," where others have found no native land mammals. Very likely his inspiration here was the black *Lepus insularis* of Isla Espíritu Santo, just north of La Paz; for he wrote the letter from La Paz. Such fantasy impugns the whole of his brief account, though that includes enough truth to suggest that he did see the island before giving free rein to his imagination.

EDWARD PALMER. Dr. Edward Palmer, a major plant explorer in the American West and in northern Mexico from 1853 to 1910, was the first naturalist to collect on Guadalupe Island. McVaugh (1956) gave a thorough and invaluable account of his life, itineraries, and plant collections; and an unpublished biography by William E. Safford adds further details, with quotations from Palmer's notes (Safford MS). Blake (1961) also quoted from Palmer's notes and gave further facts.

On reading an account of the goats on Guadalupe Island (Esperanza 1874), Palmer was inspired to collect plants there before they were all destroyed. On his first trip, in 1875, he intended to stay six weeks but was on the island from February 1 to May 16. With him as assistant was twelve-year-old Harry Bye Stewart (1862–1922) of San Diego. Palmer lived in a dugout with a roof of earth near the springs on the plateau about a fifth of the way from the north end. He did not have a boat, so could travel only overland. At first he collected in the northern part of the island, as far as he could go in a day in every direction. After the more accessible places, he "invaded the canyons," often collecting from the cliffs with a cord and noose at the end of a long pole,"which caused the men to laugh when they saw me go out to 'lasso plants', [but m]any of the species I could have gotten in no other way." However, he could scarcely have collected in lower Esparsa Canyon since he did not find several species which have survived there until recently, such as *Euphorbia misera*, *Scrophularia villosa*, *Stephanomeria guadalupensis*, *Triteleia guadalupensis*, and several others that he found only on the higher cliffs. During the last part of his stay, when supplies had run out, he was sick and feeble from an enforced diet of mostly goat meat, losing some 35 pounds, and could do little collecting.

Palmer mentioned visiting the extreme northern end of the island in early May. It appears that he got south to somewhere near Jacks Bay (West Anchorage), about two-thirds down the island — perhaps with the help of Jack the Burro; but judging from the south-end plants he did not find on this trip, he clearly did not reach the far south end. For plant

distributions he often gave "south end": but once it was "south end, especially about Jack's Bay," and for *Lycium californicum*, which does grow at Jacks Bay, he said "extreme south end." And since he cited the cypress and various plants of high cliffs as in the "middle of the island," this phrase often seems to mean well up in the northern half of the island. In quoting Palmer's distribution notes for his first trip, therefore, I put "middle" and "south end" in quotation marks.

According to McVaugh (1956:230, 354, 362), Palmer on his first trip collected some 1200 specimens (vascular plants and cryptogams) under 140 numbers, which were distributed in 11 sets, the first set at GH and some of the others traceable. Watson (1876) gave an account of the island based on Palmer's notes and listed his vascular plant collections under 119 newly assigned numbers, with 15 mostly rare plants unnumbered. Gray (1876b) and Watson (1876:124–146) proposed two new genera (*Harpagonella*, *Hesperelaea*), twenty-two new species, and two new varieties from Palmer's collections; and several other species were named later. Others reported Palmer's important collections of bryophytes, lichens, birds, land shells, and insects (McVaugh 1956:230). All together, Palmer found 119 species of vascular plants, about 12 introduced and 107 native. The plants were succumbing fast to the cresting goat population, and he was just in time to find eight natives never found on the island again: *Ceanothus cuneatus*, *Dissanthelium californicum*, *Hesperelaea palmeri*, *Micropus californicus*, *Planta* sp., *Pogogyne tenuiflora*, *Ribes sanguineum*, and *Silene antirrhina*. We can only wonder what Xántus might have found 16 years earlier. (*Phoradendron densum* was not found by Greene in 1885 and apparently was not collected again; but Bryant saw it growing on cypress in 1885.)

For his second visit, Palmer chartered a schooner and was at the island March 27 to April 3, 1889, sleeping aboard. On March 29–30 he collected Nos. 656-58 and 858-905 at the far south end. On April 1–3 he got Nos. 667-75 and 831-57 in the northeast part (McVaugh 1956:230), collecting in the canyon above the landing but not climbing to the springs. He reported that rain had been frequent this year, and his notes suggest that various of the plants were indeed lush and abundant. Vasey and Rose (1890) reported his collections (US), listing 64 species, ten of them new for the island. Rose named four new species, all from the south end: *Eschscholzia palmeri*, *Hemizonia greeneana*, *H. palmeri*, and *Sphaeralcea palmeri*, all endemic. The other additions were the native *Chamaesyce pondii*, *Spergularia macrotheca*, and *Suaeda taxifolia*, and the introduced *Centaurea melitensis*, *Melilotus indica*, and *Sonchus tenerrimus*. All together, on his two trips, Palmer collected a total of 135 vascular plants, including 15 introduced species and 120 native — out of the 156 species counted here as probably native.

E. L. GREENE. The second botanist to work on Guadalupe Island was the Rev. Edward Lee Greene, a keen student of west American plants, who by his own account had "seven days of incessant rambling and climbing" there April 20–26, 1885. He barely mentioned a fellow naturalist who, according to Jepson (1931), was George Washington Dunn. Dunn had just visited the island (*Science* 4:366, 1884) and so perhaps suggested Greene's trip. Greene (1885) gave interesting notes on the vegetation and listed his 106 collections, often with notes; he also included, each marked with a dagger, the 25 species of Palmer's list that he failed to find. He added nine native or possibly native plants: *Agoseris heterophylla*, *Arctostaphylos* sp., *Dichelostemma pulchellum*, *Eschscholzia californica*, *Filago californica*, *Lupinus guadalupensis*, *Mammillaria blossfeldiana* var. *shurliana*, *Myosurus minimus* var. *filiformis*, and *Opuntia prolifera*, the first two of which were not found again; and five weeds: *Brassica rapa*, *Chenopodium murale*, *Hordeum murinum*, *Mesembryanthemum crystallinum*, and *Polypogon monspeliensis*, the first of which was not found again but isn't missed. He proposed nine new species then and others later. Greene's mammillaria

was from "towards the south end," but he wrote that in this dry year the southern half of the island was a sunburnt waste and that most of his additions were from the vicinity of the springs, the district of highest fertility, where the goats did not now range. He remarked that the presence of the small garrison at the beach, with soldiers coming daily for water and sometimes to hunt goats, must already have had a favorable effect on the vegetation of this very best part of the island.

Greene's Guadalupe Island collections are scattered, at CAS, DS, GH, ND-G, NY, UC, US, (and others?). The Greene-Nieuwland Herbarium at ND seems to have just 13. Some specimens treated as his types are at CAS, GH, ND-G, UC.

F. FRANCESCHI. Dr. Francesco Franceschi (Emanuele Orazio Fenzi) was a noted Italian horticulturist, newly arrived in California in "1893" (Tucker 1945). In December 1892 and part of January he visited Guadalupe Island to see the state of the vegetation and to gather full particulars on trees and shrubs peculiar to the island, "of which a few have been sparingly introduced in gardens and others well deserve to be." In an interesting account of his visit, Franceschi (1893c) listed four lichens, identified by E. L. Greene, and 56 vascular plants, identified by Mrs. Katharine Brandegee (UC; duplicates at DS, POM, US). Collecting so early in the season, he added no new plants except for mentioning *Cotyledon* ___ (probably *Dudleya virens*), but his observations are astute and often colorful. He published fuller accounts of the palm elsewhere (Franceschi 1893a, 1893b) and mentioned other articles sent for publication that seem not to have appeared yet.

A. W. ANTHONY. Alfred W. Anthony of San Diego made many trips in 1887 to 1899 into northwest Baja California and to the west-coast islands, collecting birds and mammals (Nelson 1921:143). Plant collectors with him on two trips to the islands, including Guadalupe, put up many sets of specimens that were distributed with printed labels bearing Anthony's name, and he is usually cited as the collector. These are mostly numbered, but not all chronologically, and most have only inclusive dates for the trip. T. S. Brandegee probably identified the specimens, a set of which is in his herbarium (UC). Clues to Anthony's itineraries come from publications by him and his associates and from his manuscript catalogue of bird skins (Department of Birds and Mammals, California Academy of Sciences). In 1896, leaving San Diego July 9 with a chartered schooner, he was on Guadalupe Island September 17–22. James M. Gaylord was plant collector (Anthony 1896) and on the whole trip apparently made at least 148 numbered collections. In 1897 on his schooner *Wahlberg*, Anthony visited the west-coast islands and the Revillagigedos, stopping at Guadalupe March 20–26. Botanist T. S. Brandegee was with him as far as San José del Cabo, collecting for his own herbarium (see next entry). Collecting plants for Anthony for the whole trip was Alfred L. Stockton, a nephew of Mrs. Brandegee from a ranch 9 miles from Ramona, San Diego County. Anthony's numbers 231–262 are from Guadalupe.

Anthony had visited Guadalupe Island before and went again with Hanna and Slevin in 1922 (Hanna 1925, Hanna and Anthony 1923).

T. S. BRANDEGEE. Townshend Stith Brandegee was a major collector of and student of Baja California plants (Ewan 1942, Moran 1952). In 1897 he went with Anthony on the schooner *Wahlberg* to the west coast islands, visiting Guadalupe Island March 20–26. Brandegee (1900) wrote that the vegetation of Guadalupe was very rank and green but not so far advanced as that of the islands they had just visited nearer the coast. He added that most plants were not in blossom and that only at the lowest elevations could he find them suitable for specimens. Nevertheless, he collected at least 52 species, including the

following not found before: *Aphanisma blitoides*, *Capsella bursa-pastoris*, *Castilleja exserta*, *Cistanthe maritima*, *Lasthenia coronaria*, *Layia platyglossa*, *Phalaris caroliniana*, *Platystemon californicus*, *Stebbinsoseris heterocarpa*, and the endemics *Stephanomeria guadalupensis* and *Tritelcia guadalupensis*. The castilleja, lasthenia, layia, and platystemon have not been found again. Apparently he landed the first day at Northeast Anchorage. The cistanthe, phalaris, and stebbinsoseris now are local near the middle of the island on the east side, an area hard to reach afoot from the north, and evidently not visited by earlier collectors, but easy enough with the *Wahlberg*; and the aphanisma grows there and southward. From the plants he did not find, he evidently did not reach the south end. His herbarium is at UC. He later named *Castilleja guadalupensis* and *Stephanomeria guadalupensis*.

Fur Seal Trip. In the last week of June of 1897 Professors Rufus L. Green, Charles B. Wing, and Wilbur W. Thoburn, of Stanford University, visited Guadalupe Island as part of a fur seal survey. Landing at the south anchorage, the west anchorage, and the northeast anchorage, despite the late season they collected 37 species of plants (DS), reported by Dudley (1899). To the known flora they added *Frankenia salina*, *Phyllospadix torreyi*, and an endemic cistanthe described as *Talinum guadalupense*.

Harry Drent. The Brandegee Herbarium (UC) includes at least 28 specimens collected on Guadalupe Island in 1898 by Harry Drent. Among these are 15 plants Brandegee himself did not collect the year before, including such rare ones as *Crossosoma californicum*, *Phacelia phyllomanica*, and *Solanum wallacei* ssp. *clokeyi*, the previously unreported *Euphorbia misera* and *Lupinus bicolor*, and perhaps the last specimens taken of *Castilleja guadalupensis* and *Nicotiana attenuata*. According to Stewart (1965:133), "Dutch Harry" Drent, a Hollander 38 years old in 1899, "uneducated but bright," was a deep-water sailor who made at least five trips to Guadalupe Island. He hunted goats there for about five months in 1896 (San Diego *Evening Sun*, 30 Sept. 1896), for some time in 1898, and from April to late September of 1899 (Stewart 1965). In 1898 he brought to San Diego four live birds of the soon-to-be-extinct Guadalupe caracara, captured "by a trick I had learned while in South Africa" (Abbott 1933). He died in San Diego in 1910 (MacMullen 1969).

How did this goat-hunting sailor come to collect plant specimens and, even more puzzling, how could he have such a good eye for rarities? When A. W. Anthony was on Guadalupe in mid-September 1896, he could scarcely have failed to meet Drent and his fellow hunters. I suppose that after five months of goats, Drent must have been glad to visit with the naturalists and that he may have taken some interest in their collecting. Next year, in 1897, Drent was a seaman on Anthony's schooner *Wahlberg*, certainly in December (Purpus 1898) and evidently on the spring voyage to Guadalupe with Anthony and Brandegee. When Brandegee (1900:21) found few plants flowering that March, he must have asked Drent to get others for him later and *shown* him what plants to collect. Since Drent did not get them until the next year, evidently he was not staying on the island in 1897 but was indeed on the *Wahlberg*. In January 1898 Carl Purpus wrote Mrs. Brandegee that Drent was going to Guadalupe to collect palm seeds (Purpus 1898). Doubtless he also hunted goats; but clearly that was when Harry Drent turned plant collector — and proved a bright pupil.

W. W. Brown. Willmott W. Brown, Jr., studied and collected birds on Guadalupe from May 1 to June 28, 1906, accompanied by H. W. Marsden and Ignacio Oroso (Thayer and Bangs 1908, Nelson 1921). The Brandegee Herbarium (UC) includes at least 11 plant specimens collected by Brown. A few at UC and US have printed labels whose text suggests that his first set is at GH: "Presented to the Gray Herbarium by Messrs. John E. Thayer

and Outram Bangs." A check at GH showed eight specimens of *Peritvle*, some with his numbers between 4 and 84, so clearly he collected many plants. His collection of *Stephanomeria diegensis* (UC) is the only one known from the island. Since he was two months on the island and may have found other unreported plants, a list of his collections would be of great interest. However, Dr. Reed Rollins, and later Dr. David Boufford, wrote me they found at GH no fieldnotes or list of the Brown collections.

J. N. ROSE. Joseph Nelson Rose, botanist with the Smithsonian Institution, had named four new Guadalupe Island species in reporting the collections from Palmer's second trip (Vasey and Rose 1890). He visited the island himself on March 2–4, 1911, with C. H. Townsend's expedition on the U. S. Bureau of Fisheries steamer *Albatross* (Townsend 1911; Nelson 1921:146; Maxon 1935). According to Townsend "The botanical gatherings alone [from this long trip] occupied nearly half of the special freight car to which the ship's load was transferred in San Francisco." Rose's Guadalupe specimens (1600[-1604? and 1690[?) and his field notebook are at US.

HANNA, SLEVIN, AND ANTHONY. G Dallas Hanna and Joseph R. Slevin of the California Academy of Sciences and A. W. Anthony of San Diego visited the island July 11–17, 1922 on the Mexican patrol boat *Tecate*, on a trip to check on marine mammals (Hanna and Anthony 1923, Hanna 1925, Anthony 1925). They made a small collection of plants (CAS) and took some valuable 4″ × 5″ photographs, including some of oaks, pines, and cypresses published by Eastwood (1929).

MASON AND SOLIS. Herbert L. Mason of the University of California and Octavio Solis of the botanical garden at Chapultepec Park, Mexico City, visited Guadalupe Island April 19–21, 1925 (Hanna 1926). Mason collected in the canyon above Northeast Anchorage one day and at the south end the next. He got 43 species of plants, including one weed not found before, *Hypochoeris glabra*. In reporting Mason's collections (CAS), Eastwood (1929) also gave a useful summary of previous collections. There is no report of Solis' collections. At US I saw one specimen of his No. 12, *Hemizonia greeneana*, April 20. The printed label is headed: "Plants of Mexico/Received from Dirección de Estudios Biológicos, Secretaría de Fomento, Mexico"; very likely the first set is at MEXU.

J. T. HOWELL. John Thomas Howell of the California Academy of Sciences was on Guadalupe Island November 14–16, 1931, and March 16–18, 1932. In November he climbed up Barracks Canyon to the oaks the first day, visited the pines the second, and landed at Melpomene Cove the third. In March he again visited the pines; then on the second and third days, with one companion, he made the long overland trip from Northeast Anchorage to the south end, camping overnight at the southern limit of the cypresses. He made very good use of his time, on the November 1931 trip collecting numbers 8169–8223 and in March 1932 numbers 8246–8335 (CAS), including bryophytes as well as seed plants. His most remarkable discovery was *Baeriopsis guadalupensis*, which he described as a new genus and species. Beyond that, he added to the known flora seven native or possibly native species: *Atriplex californica*, *Hutchinsia procumbens*, *Lepidium nitidum*, *Plagiobothrys collinus* var. *californicus*, *Spergularia marina*, and *Trifolium gracilentum*. He also added five new weeds: *Bromus rubens*, *Medicago polymorpha*, *Mesembryanthemum nodiflorum*, *Poa annua*, and *Sisymbrium irio*. Howell (1941b) gave an interesting account of his two trips and an annotated list (1942) of the vascular plants he had found. His observations on the pines he included in a general account of the closed-cone pines of the islands (Howell 1941a). Howe (1934) reported his Hepaticae.

P. J. REMPEL. Peter J. Rempel, then of the University of Southern California, collected

about 40 numbers on Guadalupe Island July 18–19, 1937, on a cruise of the *Velero III* of the Allan Hancock Foundation (see Allan Hancock Pacific Exp. 1:46, 312.) He was the first to collect on Outer Islet and so first to find *Castilleja fruticosa*, *Eriogonum zapatoense*, *Erysimum moranii*, and *Lavatera lindsayi*; but the specimens (DS, LAM now RSA) were not identified at the time and there was no report of his collections.

GEORGE LINDSAY. George Lindsay, of the San Diego Museum of Natural History and later the California Academy of Sciences, visited Guadalupe Island several times between 1948 and 1957 and collected plants on three trips (SD). (See Lindsay 1951, 1966; Lindsay and Dawson 1952; Moran and Lindsay 1950.) **1948**, April 9–16, on Louie and Marcho Cavanagh's *Marviento* with Reid Moran (see next entry); NE Anchorage to Mt. Augusta and the cypress grove, south end mesa, Outer Islet (2800–2840). **1950**, January 27 to February 4, with Dr. Carl Hubbs, on the *Orca*; Outer Islet, Melpomene Cove, above West Anchorage, SE coast (1801–1818). **1955**, June 10-16, on the *Orca*, with Dr. Hubbs, and with Job Kuijt and Harvey A. Miller (see below); southeast sealing camp, Outer Islet, Islote Negro (2617–2644); he spent four days circumnavigating the island in a small launch and observed plants on offshore rocks.

REID MORAN. Reid Moran, of the San Diego Museum of Natural History, visited Guadalupe Island 20 times between 1948 and 1988, ashore 97 days, some short, some long (and some nights) (See Moran 1959, 1967, 1968, 1969, 1978). Most of the longer and more fruitful trips were with Professor Carl Hubbs (Fig. 73) of the Scripps Institution of Oceanography and on Scripps ships. Moran has named five endemic species and subspecies: *Castilleja fruticosa*, *Dudleya guadalupensis*, *D. virens* ssp. *extima*, *Eriogonum zapatoense*, and *Lavatera lindsayi*. To the known flora he (sometimes with botanical companions) has also added 16 other species treated here as native or probably so, and one of them as endemic, though a few may possibly be recent arrivals: *Antirrhinum watsonii*, *Camissonia robusta*, *Castilleja attenuata*, *Cuscuta corymbosa*, *Erysimum moranii*, *Gnaphalium bicolor*, *Heteromeles arbutifolia* var. *macrocarpa*, *Lomatium insulare*, *Lycium fremontii*, *Pectocarya linearis* ssp. *ferocula*, *Plagiobothrys acanthocarpus*, *Poa secunda* ssp. *secunda*, *Rhus integrifolia*, *Scrophularia villosa*, *Stipa lepida*, and *Zostera marina*; and seven clearly introduced and mostly weedy species: *Bromus hordeaceus*, *Erodium brachycarpum*, *Herniaria cinerea*, *Nicotiana glauca*, *Phalaris minor*, *Ruta chalepensis*, and *Sisymbrium orientale*. His collections from the 1948 trip are at DS, the rest at SD, as also his notebooks. **1948**, April 9–16, with George Lindsay (see previous entry), on the *Marviento*; NE Anchorage to pine ridge (over night), south-end mesa, Outer Islet (2835–2947). See Lindsay (1966), Moran and Lindsay (1949, 1950), Moran (1951). **1957**, February 9–14, with Dr. Hubbs; West Anchorage, Islote Negro, Outer Islet, NE Anchorage to Mt. Augusta with Julio Berdegué (see Berdegué 1957) and camp at spring (5602–5706). April 17–21, with Dr. Hubbs; West Anchorage, Esparsa Canyon, Islote Negro, Barracks Canyon, Pilot Rock Beach (5950–5996). October 25–30, with Dr. Hubbs and George Lindsay on the *Orca*; cliffs above NE Anchorage, Esparsa Canyon, Islote Negro, south-end mesa, south palm canyon with George Lindsay, SE sealing camp (6114–6166). December 13–18, with Dr. Hubbs and with botanists C. H. Muller (UCSB) and Gene Newcomb (UC) and C. F. Harbison (SD); up pine ridge to camp at old lookout and down by spring and Oak Canyon, lobster camp with Newcomb, lobster camp to El Picacho and south end (6420–6481). **1958**, April 22–30, on Scripps boat, to collect pine seeds for breeding program, with botanists Sherwin Carlquist (RSA, UC), Wallace Ernst, and Ira Wiggins. (Wiggins & Ernst 1–223, Ernst 259–277, DS); South Esparsa Canyon, Pilot Rock Beach to pine ridge for pine cones, Esparsa Canyon, NE Anchorage to camp at spring, then to Mt. Augusta and south to lobster camp, south-end mesa, Islote Negro, up

Arroyo Melpomene to flank of El Picacho at 650 m and down to lobster camp, NE Anchorage (6593–6771). **1960**, January 26–30, with Dr. Hubbs and class; NE Anchorage to Oak Canyon, NE Anchorage to Lower Circus, NE Anchorage to beach cliffs at canyon rim, NE Anchorage to canyon rim, Arroyo Melpomene to 600 m (7828–7851). **1965**, February 28 to March 6, with Dr. Hubbs and class; NE Anchorage to pine ridge, NE Anchorage to Lower Circus and Oak Canyon, NE Anchorage to Mt. Augusta and cypress grove, Juniper Canyon, lobster camp, Arroyo Melpomene to 400 m (12011–12078). **1967**, April 30 to May 3, with Dr. Hubbs; SW coast, Arroyo Melpomene to 350 m, NE Anchorage to Lower Circus, SE Oak Canyon, NE Anchorage to north end (13755–13822). **1968**, June 21–22, with the Pacific Project of the Smithsonian Institution, on the *Stella Polaris*; Outer Islet (over night), Arroyo Melpomene to 470 m (15113–15128). **1969**, February 21–22, a trip for Museum members; NE Anchorage, south-end mesa (15733). **1970**, April 11–22, with Dr. Hubbs; pine ridge (over night) to NW slope, Arroyo Melpomene, Long Canyon to El Picacho to south end, West Anchorage, Islote Negro (17274–17428). August 16–21, with Harold Pringle of La Jolla; NE Anchorage to Mt. Augusta and by jeep to landing strip, Esparsa Canyon, lobster camp, south end, Outer Islet (18143–18171). **1971**, May 18–23, with Dr. Hubbs; Pilot Rock Beach to pine ridge (over night) and NW slope to NE Anchorage, West Anchorage to El Picacho and gray cliff just south (18385–18397). **1973**, March 25, with tourist trip; NE Anchorage to Lower Circus (20304–20310). **1974**, March 24, with tourist trip; NE Anchorage to Lower Circus (21665–21668). **1978**, March 26–29, to collect pine cones for breeding program and for study of inbreeding in natural population, with William Libby, Ken Eldridge, Daniel Axelrod, Yan Linhart, Cliff Ohmart, plus graduate students and other helpers; to cypress grove and pine ridge (25374–25394). **1981**, May 23–24, Palm Society trip to see Guadalupe Island palm, with botanists Mitchel Beauchamp, Curtis Clark, Mary Hochberg, Steve Junak (22 specimens, SBBG), Tom Oberbauer, Ralph Philbrick, Steve Timbrook, Sherry Whitmore, Howie and Eric Wier, and others; Pilot Rock Beach up pine ridge to camp at old lookout, next day to upper NW slope (29591–29600). August 19–26, with ecologist Martín González and geologist Carlos García of Ecoterra, range ecologist Don Duncan, and Oscar Paulín of COTECOCA, making preliminary inventory of natural resources for SARH (González 1981), taking truck on Mexican LCT, *driving* to cypress grove to camp (unbelievable!), then Lower Circus, pine ridge, south-end mesa, cliffs NW of cypress (29799–29816) [unfortunately a very dry summer]. **1988**, March 28–30, with Margie Stinson on *Pacific Queen*, with several botanists, some collecting: Bruce Baldwin (688–692, DAV), Jim Bartel, Mitchel Beauchamp, Tony Burgess (7437–7469, ARIZ), Steve Junak (3469–3569, SBBG), Tom Oberbauer, Chuck Quibell (1741–1817, NCC), Fred Sproul, Robert Thorne (63011–63111, RSA), Ray Turner; NE Anchorage to spring, next day to Mt. Augusta [some to pines], south-end mesa (31000–31018).

KUIJT AND MILLER. With Dr. Hubbs and George Lindsay, Job Kuijt and Harvey A. Miller visited Guadalupe on the *Orca* June 10–16, 1955. They collected on the pine ridge, at West Anchorage, at the old sealing camp on the southeast coast, and on Outer Islet, and with Lindsay they made the first collections on Islote Negro. Kuijt collected higher plants (1001–1081, UC). Miller collected bryophytes (5502–5532, DS); and he collaborated on an account of the bryophyte flora (Crum and Miller 1956).

WEBER AND MCCOY, COPP. William A. Weber and C. J. McCoy, Jr., of the University of Colorado, visited the island April 19–29, 1963 with Dr. Hubbs. Though not reaching higher elevations, they made the first thorough collection of lichens for the island: NE Anchorage, lobster camp, south end, Islote Negro (36493–36680). They also collected vascular plants (11969 etc., COLO) and bryophytes. Scripps technician Joseph F. Copp

collected vascular plants in the same places (141–188, DS). Weber (1964, 1965, 1994) named a new genus and another new species of lichen and reviewed the lichen flora of the island.

ENRIQUE MELING. Alf Enrique Meling López, as a student at Universidad Autónoma de Baja California, in Ensenada, wrote a professional thesis on the state of the vegetation of Guadalupe Island (Meling 1985). He did field work there in the spring of 1982, the spring of 1983, and the summer of 1984. He made three long transects, listing species but not always collecting vouchers; and some of his identifications are questionable. For checking by Dr. Geoff Levin, he gave 80 specimens to SD, 46 of them numbered but not chronologically, most of them dated but 20 with only month and year; others are at ENC. Some of his localities are questionable: for example *Camissonia robusta*, *Galium aparine*, *Linaria canadensis*, *Lotus grandiflorus*, and *Uropappus lindleyi* all from "Extremo Sur," the desertic south end. However, he added three or four new weeds to the known flora: *Lamarckia aurea*, *Raphanus sativus*, *Sisymbrium irio* (perhaps a reintroduction), and *Triticum aestivum*. About his specimen of *Solanum tenuilobatum*, see Doubtful and Excluded Species, p. 168.

JOSÉ RICO C. Ing. José Rico C. of the División de Ciencias Forestales, Universidad Autónoma Chapingo, Chapingo, Mexico, visited the island in 1982 and again July 1–15, 1994, collecting many specimens (CHAP). (See Rico. C. 1983).

PHILBRICK AND JUNAK. Botanists Ralph Philbrick and Steve Junak, with Peter Schuyler, of the Santa Barbara Botanic Garden visited Guadalupe Island April 23–26, 1984, also taking entomologist David Faulkner of the San Diego Museum of Natural History. They landed near a fish camp on the southeast coast north of Morro Sur, walking inland and up the airport road to 1800 ft; they had 2 ½ hours on Outer Islet (see Philbrick 1984); and they climbed from Esparsa Canyon to Mt. Augusta. Junak collected numbers 2055–2117 and Philbrick some 64 numbers (SBBG). Faulkner also collected some plants (SD).

Junak and Philbrick also were with Moran in May 1981 and Junak again in 1988 (see above); and Philbrick visited Northeast Anchorage on a cruise boat in 1975.

Catalogue of the Plants

This catalogue aims to include all vascular plants, native and foreign, reported to grow on Guadalupe Island and its islets. An asterisk (*) before a name shows that the plant seems to be a late arrival, usually meaning a European weed (see Table 1 and discussion). A letter phi (ϕ) shows that it is a west American plant that has been taken for native but is possibly or probably introduced (see Table 2 and discussion). A dagger (†) shows that it is possibly or probably extinct on the island, commonly meaning that no one has seen it since 1900 (see Table 3 and discussion). The synonymy includes chiefly names used for the plant as it grows on this island.

The catalogue not only tells the most recently known distribution of each plant on the island but also quotes or paraphrases such early reports as suggest differences in the past, thus often telling of the decline of natives and the spread of weeds. These reports thus sometimes give clues to the drastic but little documented changes in the vegetation that took place in a very few years, even between Palmer's visit of 1875 and Franceschi's of 1892, when the goats apparently were just reaching their greatest numbers. The map (Fig. 2) shows place names used in this account; for other names see under Place Names, p. 9.

Because the Guadalupe flora is most closely related to the floras of the other Pacific islands of southern California and Baja California (Fig. 1), the catalogue also notes occurrence on those islands. Useful sources of this information are Wallace's (1985) tabulation of floras of the Channel Islands, plus the floras of the Islands of Santa Cruz (Junak et al. (1995), San Nicolas (Foreman 1967), Santa Barbara (Philbrick 1972, Junak et al. 1993), Santa Catalina (Thorne 1967, 1969), San Clemente (Raven 1963, Thorne 1969), Todos Santos (Junak and Philbrick 1994a), and San Martin (1994b).

The catalogue does not describe most plants but does include some descriptive notes and even full descriptions when they can tell something new, as well as thumbnail descriptions for some interesting endemic plants. It cites specimens mainly for those plants that are rare or seldom collected, and the account of collectors (p. 44) tells for each one where the first set of specimens is deposited. Herbarium abbreviations follow Holmgren et al. (1990). Field numbers prefixed by "M" are mine, and my collections since 1948 are at SD.

Although this is the very latest flora of Guadalupe Island, it cannot be called up-to-the-minute. My visits to the island, and so my observations of the plants, were scattered over 40 years, from 1948 to 1988 (see p. 50). Where I could go on the island was always limited by time and by trip goals. On the latest trips I could not revisit all the remote spots where I had seen rare plants before, to see whether they still survived. Thus some of my sightings are long out of date, and I can't know whether the plants are still there.

FERNS

Polypodiaceae s.l.

Cheilanthes newberryi (D. C. Eaton) Domin, Biblioth. Bot. 20 [Heft 85[1]]:133. 1915.

Notholaena newberryi D. C. Eaton, Bull. Torrey Bot. Club 4:12. 1873.

RANGE. — Southern California and NW Baja California; San Clemente Island.

Palmer found this fern throughout the island, on rocks in dry exposed places (Watson 1876:122). It is fairly common from Northeast Anchorage and the Lower Circus to Arroyo Melpomene and the southeast sealing camp. Rolla Tryon (1956:45) cited Guadalupe Island collections by Palmer, Franceschi, Anthony, Rose, and Mason.

Notholaena californica D. C. Eaton, Bull. Torrey Bot. Club. 10:27. 1883.

RANGE. — Southern California to Arizona, Sonora, and central Baja California; Santa Catalina Island.

This fern is known on Guadalupe Island from only two collections: locally common in rock crevices, head of east fork of Arroyo Melpomene at 210 m (*M6165*); southeast coast just north of Morro Sur, *D. Faulkner 7D* (SD). Dr. Dale Benham, who has the specimens on loan, tells me they are the form with yellow farina, which has been called ssp. *californica*.

Pellaea mucronata (D. C. Eaton) D. C. Eaton var. ***mucronata***

Pellaea ornithopus Hook., Sp. Fil. 2:143. 1858.
Pellaea mucronata (D. C. Eaton) D. C. Eaton in Emory, Bot. Mex. Bound. 2(1):233. 1859.

RANGE. — California to southern Nevada and northern Baja California; Santa Rosa, Santa Cruz, Santa Catalina, and San Clemente Islands.

Palmer found this fern rare, in crevices of the highest cliffs (Watson 1876:120); and Franceschi (1893c:139) called it the scarcest fern on the island, seen only at the eastern side, on basaltic rocks fully exposed to the sun. From Guadalupe Island, A. Tryon (1957:159) cited only Palmer's specimen. More recent collections are: two in crevice of Lower Circus at 950 m (*M7838*); one clump in rock crevice, head of east fork of Arroyo Melpomene at 210 m (*M6166*).

Pentagramma triangularis (Kaulf.) Yatsk., Windham, & E. Wollenw., Amer. Fern Jour. 80:15. 1990.

Gymnogramma triangularis Kaulf., Enum. Fil. p. 73. 1874.
Pityrogramma triangularis Maxon, Contr. U. S. Natl. Herb. 17:173. 1913.

RANGE. — British Columbia to Nevada, Sonora, and southern Baja California; San Miguel, Santa Rosa, Santa Cruz, Anacapa, San Nicolas, Santa Catalina, San Clemente, and Cedros Islands.

Palmer found this fern in crevices of the highest cliffs in the "middle" and at the "south end" of the island (Watson 1876:120). Franceschi (1893c:139) called this the most widely spread fern, growing luxuriantly in the crevices of rocks with northern exposure, also in very dry sunny spots but then much reduced in size. They grow on cliffs in the northeast part of the island and as far south as Juniper Canyon but are not very common.

The *Pentagramma triangularis* complex, as now imperfectly understood, is "a confusing array of morphologically cryptic taxa" (Yatskievych et al. 1990), "a puzzling complex of intergrading chemical, chromosomal, and morphological variants" (Smith and Lemieux 1993), which is variously subdivided and is still due for more study. Alt and Grant (1960) included Guadalupe Island in the range of var. *maxonii*, which they did not study in detail. Dale Smith has annotated Guadalupe specimens as varieties *maxonii* and *triangularis*; and George Yatskievych wrote me that one of the plants under *Palmer 101* at MO

FIGURE 36. *Pentagramma triangularis* (*M17317*) on cliff at north end of the island, 800 m, 13 April 1970.

is ssp. *viscosa*, though a bit more divided-leaved than usual. He said he had seen little Guadalupe material and most of that was pretty weird. I am a coward, just calling it all *P. triangularis*. Figure 36 shows a form with fronds much as in typical *triangularis* but viscid.

Polypodium californicum Kaulf., Enum. Fil. p. 102. 1824.

RANGE. — Central California to NW Baja California; Santa Cruz, Santa Rosa, Anacapa, San Nicolas, Santa Barbara, Santa Catalina, San Clemente, Los Coronados, Todos Santos, and Cedros Islands.

Palmer found this fern abundant at the north end, in cracks of rocks in damp places, sometimes covering large surfaces (Watson 1876:120), but Franceschi (1893c:139) called it rather scarce, always in shady or sheltered localities. It grows at 600–900 m, mostly in damp and shady places: on the north slope under the pines and on north cliffs, on the south wall of Oak Canyon, and with the mimulus on the gray cliff above Campo Oeste, in a spot that is perhaps often foggy. I have not seen it abundant.

Polypodium scouleri Hook. & Grev., Icon. Fil. 1: pl. 56. 1829.

RANGE. — Vancouver Island along the coast to central California; Santa Cruz and Guadalupe Islands.

Palmer found this fern encircling the trunk of a single oak in a thick mat of moss and constantly wet by the fogs, covering the tree with a network of its strong tough roots to the height of ten feet (Watson 1876:120). Greene (1885:228) feared that "Dr. Palmer's

gathering of it from 'the trunk of a single oak' may have proved the extermination of the species on this island." Evidently, though, Greene was looking up the wrong tree, for Hanna and Slevin again found it on oaks (Eastwood 1929:399). I found it on the trunks of two pines on the northeast ridge at 530 m (*M6422*), as well as on northwest-facing vertical cliffs nearby and farther towards North Point, at 460 m (*M6420*). The fern-bearing trees seem to be gone, but the cliff is still there and I hope also the fern.

Polystichum munitum (Kaulf.) C. Presl, Tent. Pterid. p. 83. 1836.

Aspidium munitum Kaulf., Enum. Fil. p. 236. 1824.
Polystichum munitum (Kaulf.) C. Presl ssp. *solitarium* Maxon, Fern Bull. 11:39. 1903.
Polystichum solitarium (Maxon) Underw. ex Maxon, Contr. U. S. Natl. Herb. 10:493. 1908.

RANGE. — Alaska to Montana and southern California; Santa Rosa, Santa Cruz, and Guadalupe Islands.

Palmer saw only two large bunches of this fern, at the northern end in a rocky place inaccessible to goats and constantly damp from the prevalent fogs (Watson 1876:120). Though seldom collected, it persists on the sheer northwest cliff at 600 m near North Point (*M29591*), where noted by Sherry Whitmore.

Maxon (1903) wrote that his ssp. *solitarium* was distinguished by the dark persistent chaff which very thickly covered the rachis throughout and by the narrower and extremely coriaceous pinnae, which were more scurfy below and somewhat glaucous in appearance and possessed of abbreviated decidedly cartilaginous appressed incurved teeth. The holotype is *Anthony 9* of 1896 from Guadalupe Island (GH); and *Palmer 102* is a paratype. David Wagner annotated my collection (*M29591*) in 1989 as *P. munitum*. See Wagner (1979).

GYMNOSPERMS

Cupressaceae

Cupressus guadalupensis S. Watson ssp. ***guadalupensis***

Cupressus guadalupensis S. Watson, Proc. Amer. Acad. Arts Sci. 14:300. 1879.
Cupressus macrocarpa Hartw. var. *guadalupensis* (S. Watson) Mast., Gard. Chron. Ser. 3, 18:62. 1895.
Cupressus macrocarpa of Guadalupe Island references.

RANGE. — Endemic to Guadalupe Island.

Tree 15–20 (–25) m tall, the crown dense to rather open, commonly rounded or subrounded, in isolated trees often broader than high, occasionally pointed, the main axis identifiable nearly to top or often lost in branches (Figs. 37, 38). Trunk mostly 2–5 dm thick, often to 1 and rarely to 2 or reportedly 2.5 m, in age often fluted (Fig. 39); primary branches mainly ascending at about 45–60°, the lowest 1–2 m above base (Fig. 39); bark of trunk and branches commonly smooth, peeling annually in thin non-fibrous curling plates two to several centimeters long and wide, the new bark pink to reddish to greenish, mostly soon aging various shades of gray to lavender gray, but in a few trees the bark on branches smooth but on trunks persistent, fibrous or often shaggy, brown, splitting lengthwise into strips. Foliage green to rich glaucous blue-green, glaucous especially on young trees. Ovulate cones 24–40 (–50) mm long, nearly as thick, generally with 8 or 10 scales, often

FIGURES 37 and 38. Guadalupe cypress (*Cupressus guadalupensis* ssp. *guadalupensis*), showing variation in shape and density of crown
FIGURE 37. Tree on the western escarpment, 27 March 1978. FIGURE 38. Trees in the main grove, 2 March 1965.

with conspicuous horns which may be 6 mm long.

Palmer reported only that the cypress grew in irregular clusters in the "middle" of the island (Watson 1876:119); he called it a fine widely spreading tree, though varying much in habit, averaging about 40 feet high. According to Greene (1885:217) "this tree appears formerly to have occupied almost the entire plateau of the northern half of the island; but now, upon the greater part of this tract, only the fallen trunks, far gone in decay, remain. The cause of this destruction I cannot guess." He mentioned that the cabins near the springs stood in a fine cypress grove. Franceschi (1893c:138) wrote that the principal grove on the higher central plateau covered not less than two or three square miles. Dudley (1899:281) wrote that samples of dead wood from the southern part of the island agreed in structure with cypress wood and not with juniper wood which had previously been supposed to occur there. He concluded that "the cypresses, therefore, probably extended over the southern half of the island until destroyed by the goats; and their disappearance may have caused the disappearance of subperennial springs, as none exist in that region." It is not clear how far south or at how low an elevation the wood was collected, but I suspect that Dudley's conclusion is much too sweeping. Furthermore, Palmer saw not merely dead wood but also living junipers in the "central" and "southern" part of the island, and indeed Dudley reported dead junipers.

Cypresses now grow mainly on the comparatively gentle western and southern slope of the island in the vicinity of Mt. Augusta, at about 950 to 1200 m elevation. The main grove extends from about west of Mt. Augusta around to the south-southeast, with a more scattered stand to the northwest. The total number of trees must be in the thousands. On the bench near the spring one old dead tree remained at the time of my first visits but is now gone. The only trees on the eastern drainage are a few at the head of the canyon just south of Mt. Augusta. Fallen trees are especially numerous in the area from west to northwest of Mt. Augusta, and more fallen ones were seen each trip. The southern part of the grove is still a beautiful dense forest (Fig. 25), but many trees show severe damage to the bark by the goats. As with the other trees of the island, no seedlings escape the goats. Although in dense parts of the grove trunks may be as thin as 1 dm, they must all be well over 100 years old.

After the visit of Mexican President López Portillo on September 28, 1980, there was a plan to fence the cypress grove and keep the goats out, to raise cypress seedlings at the Tecate nursery from Guadalupe seed, and to replant bare areas. However, the fence was never finished, and the project clearly was abandoned.

Franceschi (1893c) called attention to the great variation of the cypress in habit and color and also in size and shape of the cones. Howell collected a series of specimens to show the variation and gave notes on his observations. I also was impressed with the great variation, as expressed in the description above, the crown dense to open (Figs. 37, 38), the bark smooth to shaggy and persistent (Figs. 39, 40), the foliage green to very glaucous, and the cones (Fig. 41) varying greatly in size and shape.

A related tree in Orange and San Diego Counties, California, and in northwest Baja California was sometimes called *C. goveniana* Gordon or *C. sargentii* Jeps. but was then more commonly called *C. guadalupensis*, as by Abrams (1923:73). Jepson (1922) named this mainland tree *C. forbesii* but did not differentiate it from other species. In his thorough revision of New World cypresses, Wolf (1948a), after discussing the difficulty of specific and subspecific delimitation, recognized 15 species and no varieties. He kept *C. forbesii* as a species closest to *C. guadalupensis* but said (p. 5) that a most drastic reduction of

FIGURES 39 and 40. Guadalupe cypress (*Cupressus guadalupensis* ssp. *guadalupensis*). FIGURE 39. Tree with 6-foot fluted trunk, showing branching and showing smooth-peeling bark, 13 February 1957. FIGURE 40. Trunk with shaggy bark, 23 August 1981. (The tree is described as having smooth cherry red bark.)

FIGURE 41. Foliage and cones of *Cupressus guadalupensis* ssp. guadalupensis (*M5671*). 13 February 1957

species might place it as a subspecies of *C. guadalupensis* or even reduce it to synonymy. Little (1970) discussed the problem further and proposed a more conservative treatment. Thus where Wolf accepted 15 species for the New World, Little had 8 species and 7 additional varieties, with *forbesii* as a variety of *C. guadalupensis*. Silba (1981) had 8 species and 9 additional varieties, including *C. guadalupensis* var. *forbesii*.

Wolf did not visit Guadalupe Island but had to rely on the herbarium specimens of Franceschi, Anthony, Hanna, Fleming, and Howell, plus cultivated trees. Possibly the island trees he saw in cultivation were a biased sample, grown from seeds from trees selected for their glaucous foliage as more ornamental. For *C. forbesii* he saw only two collections from Baja California, whereas well over a dozen localities are now known (Minnich 1987, fig. 4). Wolf said the two species were alike in having smooth cherry-red or mahogany-brown exfoliating bark on their trunks and branches; they generally developed a branched crown with several leaders instead of retaining a single central axis; the foliage was remarkably alike, despite a difference in color, with the dorsal glands, when visible, usually inconspicuous and rarely if ever active; and they both had large cones, with large brown or tan seeds. He said that *C. guadalupensis* was a larger tree in the wild as well as in cultivation; usually with bluish green or glaucous blue-green instead of green foliage; with generally larger ovulate cones, attaining a maximum length of 45 mm, whereas in *C. forbesii* they are rarely over 30 mm long; with the inner faces of the cone scales glaucous and the seeds usually glaucous. He added that with the limited material of *C. guadalupensis* examined, it seemed that the staminate cones generally had as many as 18 scales and were therefore much larger than those of *C. forbesii*, which had only 12 or 14 scales; and his key shows scales 14–18 for *C. guadalupensis* and 10–14 for *C. forbesii*.

Wolf described *C. forbesii* as usually less than 10 m high, with a trunk 3–5 dm thick; but according to Parish, as quoted by Wolf (p. 64), trees on Mt. Tecate had trunks sometimes nearly 1 m thick. Since, however, as Wolf pointed out (p. 162), recurrent brush fires have prevented the survival of old trees, the maximum size of mainland trees is unknown. Although Wolf's description of *C. guadalupensis* said the trees varied from slightly blue-green to rich glaucous blue-green, the notes he quoted on *Howell 8299* say "with very green, non-glaucous leaves"; and I have seen many green trees. With more material, the suggested distinction in number of scales of the staminate cones does not hold. For example, one collection from Guadalupe Island (*Ramsay & Peterson s.n.* SD) has mostly 8–12, and one from south of Tecate (*M13986*) has mostly 16–18. In specimens from Guadalupe Island, the seeds may lack glaucousness. However, the difference in size of ovulate cones is impressive. For 42 cones from the island, all from different trees (*M5671, M25384*), I found a range in length of 24–38 mm, with a mean of 29.5 ± 0.34 mm. For mainland trees I measured 79 cones on 28 herbarium specimens (SD) from 14 localities in Baja California and about 8 localities in southern California. The range in length was 14–29 mm, with a mean of 21.5 ± 0.35 mm.

Zavarin et al. (1967) studied the distribution of tropolonic heartwood constituents in various species of *Cupressus*. For *C. forbesii* and *C. guadalupensis* they found common constituents separating these two from other U. S. coastal cypresses, but their preliminary data based on small samples did not show substantial differences between the two. Dr. Zavarin wrote me in 1994 that he and his associates are continuing their work, using terpenoids from leaves. They have sampled four U.S. populations out of many populations of *C. forbesii* and eleven cultivated trees of undocumented origin for *C. guadalupensis*. They have found only small differences between two populations of *C. forbesii* and for some terpenes highly significant differences between those populations and their sample of *C. guadalupensis*. He writes that the chemical data so far suggest an appreciable gap between *C. forbesii* and *C. guadalupensis*. Considering the great morphological variation in the island population, however, it might not be surprising to find great chemical variation as well. At least it would seem to require some large and well-selected samples to show significant differences between island and mainland trees as a whole.

My impression is that the trees on the island seem more variable than those on the mainland, and in many respects variation in the island population seems to more than encompass that in the various mainland populations. However, the remarkable difference in cone size suggests that mainland trees be separated subspecifically, as *C. guadalupensis* ssp. *forbesii* (Jeps.) R. M. Beauchamp.

Guadalupe cypress grows well in central and southern California, making a handsome tree. The oldest in cultivation are said to be from seed Palmer collected on his first trip. Wolf (1948b:389) told of many fine old trees 50 or 60 feet high and 30 or 40 feet wide, with trunks to 4 feet thick, adding that he had never found cones. Wagener (1948:299) told of an experimental planting of twenty trees of *C. guadalupensis* at Stanford University, with *C. macrocarpa* Gordon and others. He said they grew almost as fast as *C. macrocarpa*, in both height and diameter. Among the test species he found *C. guadalupensis* outstanding in character, growth rate, ability to compete with surrounding trees, and freedom from pests and diseases. He found it apparently not at all susceptible to cypress canker fungus (*Coryneum cardinale* Wagener), so destructive of *C. macrocarpa*. He concluded that Guadalupe cypress deserves wider use.

Juniperus californica Carr., Rev. Hort. Sér. 4, 3:352. 1854.

RANGE. — Central California to S. Nevada, NW Arizona, and north central Baja California; Isla Cedros.

On his first trip, Palmer found the juniper all over the "middle" of the island and occasionally at the "south end," in the ravines and low valleys (Watson 1876:119). Only ten years later, Greene (1885:217, 218) found it "upon the very verge of extermination. . . . Of the grove in the middle of the island [there remained] only three trees that were not quite dead; and on these three only a few tufts of green twigs gave the feeble sign of nearly exhausted vitality." The fur seal party in 1897 found many dead but no living trees (Dudley 1899:281). About 1.5 or 2 miles south of the cypresses in 1932, Howell (1941b:40) found a ghost grove which he took to be what was left of the juniper grove described by Palmer, the dead remains extending for several miles.

However, Greene in 1885 did note one vigorous juniper on a southeastern cliff, hanging over the sea. In that part of the island, where goats are fewer though still too many, a few junipers have survived until recent years, showing more damage with each of my visits. In June 1955 Job Kuijt (*1077*) and George Lindsay (*2635C*) collected from a juniper in a canyon bottom about a mile north of the southeast sealing camp; it was about 5 m tall and wide, only partly alive, the goats having eaten as high as they could reach. In 1957 at 275 m in Juniper Canyon there were two healthy erect trees 5 m tall, with rounded crowns 6 m wide. Near the mouth of the canyon, at 40 to 125 m were many dead junipers and four living ones, though two were badly damaged. One gnarled sprawling tree was 4 m high and 10 m wide, with a trunk 3 dm thick (*M6454*). In 1965 two of the four were dead and only one remained in good condition. In the next canyon south, dead junipers extended to 350 m, where a healthy one 4 m high and 8 m wide (*M12062*) hung from the south wall of the canyon, out of reach of goats (Fig. 30). In January 1960, when climbing the southeast slope west of the barracks at Northeast Anchorage to check a shrub of *Malosma* at 300 m, I saw beyond it, too far for certain identification and beyond the reach of man and goat, a healthy shrub of what appeared to be juniper.

Pinaceae

Pinus radiata D. Don var. ***binata*** (Engelm.) Lemmon, W. Amer. Cone-Bearers p. 42. 1895.

Pinus insignis Loud. var. *binata* Engelm. in W. H. Brewer & S. Watson, Bot. Calif. 2:128. 1880.
Pinus radiata D. Don forma *binata* (Engelm.) J. T. Howell, Leafl. W. Bot. 3:3. 1941.
Pinus radiata D. Don forma *guadalupensis* J. T. Howell, Leafl. W. Bot. 3:3. 1941.
Pinus radiata D. Don ssp. *binata* (Engelm.) E. Murray, Kalmia 12:20. 1982. [Basionym incorrectly given as *P. radiata* var. *binata* Engelm.]
Pinus muricata, *P. remorata*, and *P. radiata* forma *radiata* of Guadalupe Island references.

RANGE. — Endemic to Guadalupe Island.

Palmer reported the pine from high elevations at the northern end of the island (Watson 1876:119). Franceschi (1893c) said they extended all over the northern and northwestern part, which in times past they must have covered in a very thick forest, the finest trees growing amongst the palms. In my time the main pine grove has been on the northwest slope of the island near the crest of the northeast ridge, at about 300 to 800 m (Figs. 20, 21, 42). On the hotter and drier southeast side of this ridge, where the fog commonly

FIGURE 42. The endemic Guadalupe Island pine (*Pinus radiata* var. *binata*) at the old lookout, 800 m, 13 April 1948. This tree was ca. 30 m tall with a crown 32 m wide and a trunk 2.1 m thick—the largest pine seen and larger than any Monterey pine measured on the mainland

dissipates as it blows across the ridge, a few trees grew only just below the crest (Fig. 22). The northeasternmost trees were within ± 1 km of North Point (Fig. 19). A few small groups were scattered above the main grove, up the ridge to the southwest, in 1957 still to 1160 m, and a few large pines were scattered on the northwest slope among the palms. In a panoramic view from the northwest, Libby et al. (1968, fig. 1) showed most of the pines on the island in 1957.

From two short days of sampling in March 1964, Libby et al. (1968) counted only 383 living pines but said their census, particularly of trees low on the cliffs and in canyons, was approximate. A census in 1978 showed that about 5–10 percent of the trees seen in 1964, and all the seedlings, had since died (Libby 1978). Many fallen trees are to be seen (Fig. 19), and the decline continues rapidly.

Although earlier botanists reported only *Pinus radiata* var. *binata* from the island, Mason

(1932) added *P. muricata* D. Don, and McMinn and Maino (1935) included Guadalupe in the range of *P. remorata* Mason. After studying variation on the island, however, Howell (1941a) concluded that all the pines belong to one variable species; and Newcomb (1959), Libby et al. (1968), Axelrod (1980), and Millar et al. (1988) have agreed. Howell found a few trees with cones very similar to those of typical *P. radiata* on the coast of central California — [reflexed and] very asymmetrical, with umbos of the outer scales much thickened — and a few with [spreading] almost symmetrical cones, with the scales alike on all sides; but most had intermediate cones, somewhat asymmetrical, with the outer scales noticeably but not prominently umbonate. (See Figures 43, 44.) Finding complete intergradation among the three types, and finding no other differences correlated with those in the cones, Howell treated them all as forms of one species. Whereas Engelmann had separated the Guadalupe tree as variety *binata* on the basis of paired needles, Howell found that on vigorous shoots the needles are mostly in threes, as in typical *P. radiata*. So he did not take up the variety but instead named three formae based on the three types of cones: forma *radiata*, with very asymmetrical cones, forma *guadalupensis*, with nearly symmetrical cones, and forma *binata*, with intermediate cones like those of the type collection (*Palmer 90*, MO).

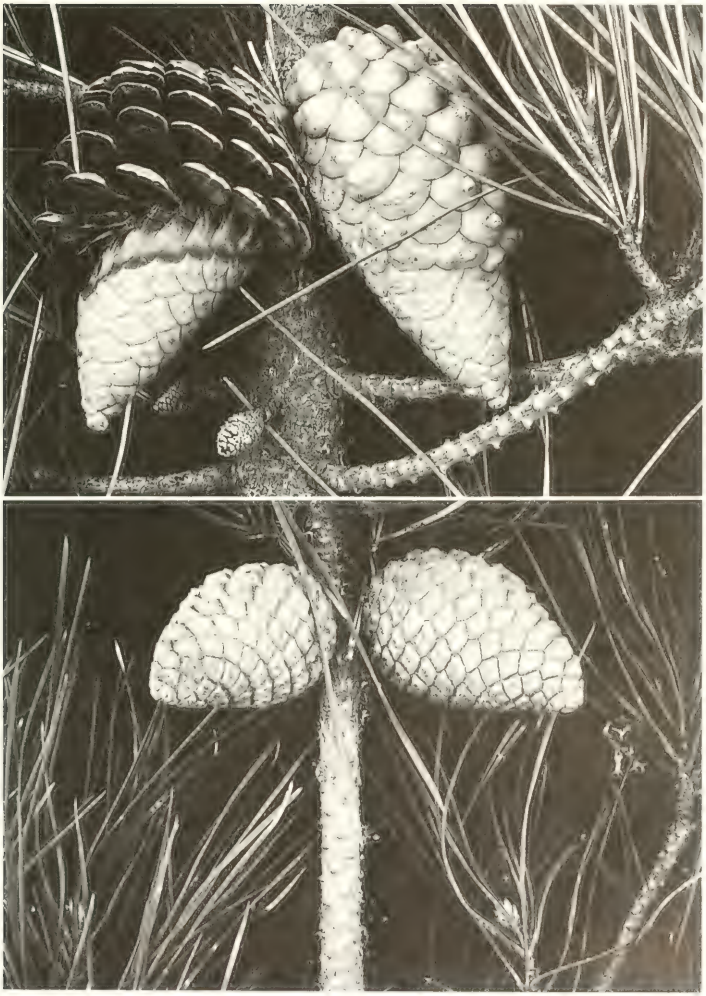
The pine of Cedros Island was formerly called *Pinus muricata* D. Don or *P. muricata* var. *cedrosensis* J. T. Howell, though Mason (1930) referred Anthony's 1896 specimen (UC) to *P. remorata* Mason. However, recent students have agreed that the Cedros pine is another form of *P. radiata* (Newcomb 1959, Libby et al. 1968, Axelrod 1980, Millar et al. 1988), and Axelrod named it *P. radiata* var. *cedrosensis* (J. T. Howell) Axelrod.

Forde (1964) found that in the Californian populations of *P. radiata* each needle has zero to two resin canals; whereas for Guadalupe and Cedros trees Newcomb (1959) reported the number as two to several.

As in *P. radiata*, so also in *P. muricata*, the cones of different trees vary from spreading and nearly symmetrical, with thin cone scales, to reflexed and very asymmetrical, with the outer scales (away from the branch) greatly thickened. Linhart (1978) supported the old view that thick cone scales are adapted to protect the seeds from fire and the newer view that they also tend to protect the seeds from squirrels. In both species, mainland trees where there are squirrels have mostly very asymmetrical cones; and the populations with the greatest proportion of nearly symmetrical cones are on islands with no squirrels, *P. radiata* on Guadalupe and *P. muricata* on Santa Cruz. Axelrod (1980) rejected these ideas, suggesting instead that larger cones with thicker scales protect the seeds against summer drought and developed in the Californian populations with the trend to increasing summer drought. He suggested that ancient types have persisted on Cedros and Guadalupe Islands, where he supposed there still were summer rains.

Axelrod compared large samples of cones from Guadalupe and Cedros Islands with samples from the three mainland populations of *P. radiata* and from all known fossil sites. He showed (1980, fig. 2) that cone size was significantly different in each of the five living populations, with Cedros cones smallest (mean length 6.5 ± 1.3 cm) and Guadalupe cones next (8.2 ± 1.2 cm), as compared to 9.6 ± 1.3 cm, 11.4 ± 1.4 cm, and 13.9 ± 1.7 cm for the three Californian populations. The oldest fossils also had small cones, some floras 2–7 million years old with cones about the size of Guadalupe cones.

The Guadalupe population thus is significantly different in cone size from other living populations. Also, Linhart (1978:36) called it the only population with a high frequency (over 30%) of thin-scaled [nearly symmetrical] cones. It is also noteworthy that the maxi-



FIGURES 43 and 44. Cones of Guadalupe Island pine (*Pinus radiata* var. *binata*) from neighboring trees, 14 December 1957. FIGURE 43. Cones of the reflexed asymmetrical *radiata* form (*M6431*) FIGURE 44. Cones of the spreading nearly symmetrical *remorata* form (*M6432*)

mum [basal] trunk diameter of 2.71 m noted by Howell is greater than the 1.83 m d.b.h. recorded for the largest mainland tree measured (Libby et al. 1968). The largest tree I measured (*M6432*), just south of the rock shelters at the old lookout (Fig. 42), had a trunk diameter at breast height of 2.1 m, a branch spread of 32 m, and a height of ± 30 m, as estimated from a photograph showing the full branch spread. The top has since broken out of this tree.

On the basis of allozymes, Millar et al. (1988) agreed that the five living populations of *P. radiata* are well differentiated. They found the Guadalupe and especially the Cedros populations highly variable. All together then, the Guadalupe population is amply distinct from other native populations and seems best kept as a geographical variety or subspecies.

Pinus radiata is probably the most widely planted tree species in the world, frequent in both landscape and forest plantings in most countries of Mediterranean climate (Libby et al. 1968). Under the name of radiata pine, it is especially important in the forest economies of New Zealand, Chile, and Australia; and worldwide it makes up an increasing share, now about three percent, of the international trade in wood and wood products (Libby 1995). It is becoming a domesticated plant and one of the best known plants genetically, and genetic improvement requires bringing in genes of all native populations, including the Guadalupe trees (Libby 1990). Many cones were therefore collected on Guadalupe in 1958, 1964, and 1978, and seedlings are now growing in California, Australia, New Zealand, and elsewhere. Forest geneticists consider that Guadalupe trees are valuable for good growth form and high wood density and may be more resistant to winter cold and to relatively hot and dry climates. And they are less susceptible than California trees to some diseases, such as Western gall rust (*Endocronartium harknessii*) (Old et al. 1985), that are serious threats to radiata pine throughout the world, and so can help in breeding for resistance.

DICOTS

Aizoaceae

Mesembryanthemum crystallinum L., Sp. Pl. p. 480. 1753.

Gasoul crystallinum (L.) Rothm., Notizbl. Bot. Gart. Berlin 15:413. 1941.

RANGE. — Native to Africa; a widespread weed along the coast of western North America and elsewhere.

Greene (1885:223) found this weed on the beach at the landing [Northeast Anchorage], and Dudley (1899:282) reported it from the south anchorage. It is now one of the commonest plants in the southern part of the island and on the islets (Fig. 74) and, though much less common in the northern part, occasional even at the spring and the pine grove.

Mesembryanthemum nodiflorum L., Sp. Pl. p. 480. 1753.

Gasoul nodiflorum (L.) Rothm., Notizbl. Bot. Gart. Berlin 15:413. 1941.

RANGE. — Native to Africa; a common weed along the coast of southern California and northern Baja California.

Howell (1942:148) was first to find this weed on the island, at the south end. It is now

rather common in the southern part of the island, including Islote Negro, and occasional farther north, even to the spring.

Anacardiaceae

Malosma laurina Nutt. ex Abrams, Fl. Los Angeles, ed. 2, p. 220. 1917.

Rhus laurina Nutt. in Torr. & A. Gray, Fl. N. Amer. 1:219. 1838.

RANGE. — Southern California to southern Baja California; Santa Catalina, San Clemente, Todos Santos, and Cedros Islands.

Palmer saw only four shrubs, in the crevices of high rocks (Watson 1876:114). Franceschi (1893c:135) saw what he took to be the same four, growing not far apart on the basaltic cliff east of the cabins; and Dudley (1899:282) mentioned the same. Franceschi also saw another, too high up to be surely identified, on the right bank of the canyon near the landing. Barkley (1937:417) cited Franceschi's specimen and also those of Drent and of Brown. On early trips I saw four shrubs on the vertical cliffs of the Lower Circus at 900 m, large and old and undoubtedly those seen by earlier botanists; but by 1981 only three remained (Fig. 29). A fourth one, doubtless that mentioned by Franceschi, grows at 300 m on the southeast slope of Barracks Canyon near the mouth: I checked it with field glasses from 50 m, which is about as close as anyone but a goat would care to go.

Rhus integrifolia (Nutt. in Torr. & A. Gray) W. H. Brewer & S. Watson, Bot. Calif. 1:110. 1876.

RANGE. — Southern California and NW Baja California; San Miguel, Santa Rosa, Santa Cruz, Anacapa, Santa Catalina, San Clemente, Los Coronados, Todos Santos, and Cedros Islands.

Moran (1951:157) reported this shrub from the inner slope and floor of the crater on Outer Islet, where it is fairly common with *Lycium californicum* and *Cistanthe guadalupensis* (Fig. 48). No one has ever found it on the main island.

Boraginaceae

Amsinckia menziesii (Lehm.) A. Nelson & J. F. Macbr., Bot. Gaz. 61:36. 1916.

Amsinckia intermedia, *A. spectabilis*, and *A. vernicosa* of Guadalupe Island references.

RANGE. — British Columbia to Idaho, Utah, and NW Baja California; South America; Santa Cruz, Anacapa, Santa Catalina, and Cedros Islands.

Palmer found this plant very abundant on level ground at the "south end" (Watson 1876:118). It is widespread from low elevations in the northeast part of the island, as at Northeast Anchorage and in Esparsa Canyon, to the flanks of El Picacho at 600 m and the mouth of Arroyo Melpomene, but usually just a few scattered plants. Flowers are February to May.

Dr. Peter Ray wrote me in 1958 that at GH he was able to find only one sheet of Palmer's original collection (No. 69), with only one small immature specimen, lacking nutlets. (If the plant was abundant as reported by Palmer, it seems strange that this should be the only specimen.) He found it labeled in Gray's hand as *A. vernicosa* Hook. & Arn.; but

since Gray did not cite this specimen in his later work, Dr. Ray suggested that this identification may have been hasty or without conviction. He referred the specimen to *A. menziesii* in accordance with the treatment of Ray and Chisaki (1957).

Cryptantha foliosa (Greene) Greene, Pittonia 1:113. 1887.

Krynitzkia foliosa Greene, Bull. Calif. Acad. Sci. 1:205. 1885.
Eritrichium muriculatum of Guadalupe Island references.

RANGE. — Endemic to Guadalupe Island.

This is a stiffly erect, divaricately branched annual 0.5–4 dm high, with leaves 1–6 cm long, and with 4 homomorphous nutlets.

Palmer found this plant in warm clear places in the canyons of the "middle" of the island (Watson 1876:118). It is widespread on the island, from the pine ridge and north slope to Outer Islet, often seen on grassy slopes, one of the commonest native annuals and in good years so abundant as to color the slopes bluish white. It flowers January to June.

Johnston (1925:63) wrote that this species was readily recognized by its peculiar habit of branching, congested spikes, coarsely armed calyx-lobes, and small nutlets. Besides the type collection of Greene ("isotypes" GH, UC), he cited specimens of Anthony, Brandegee, Palmer, and Townsend.

Cryptantha maritima (Greene) Greene var. ***maritima***

Krynitzkia maritima Greene, Bull Calif. Acad. Sci. 1:204. 1885.
Cryptantha maritima (Greene) Greene, Pittonia 1:117. 1887.
Cryptantha maritima (Greene) Greene var. *genuina* I. M. Johnst., Contr. Gray Herb. 74:48. 1925.
Eritrichium angustifolium, *E. ramosissimum*, and *Krynitzkia ramosissima* of Guadalupe Island references.

RANGE. — Southern California to Arizona and southern Baja California; San Nicolas, Santa Barbara, Santa Catalina, San Clemente, Los Coronados, San Benito, and Natividad Islands.

Palmer found this plant on level spots at the "south end" and also near the beach on the eastern side (Watson 1876:118). It is widespread at low elevations, from Northeast Anchorage to the south end and on Islote Negro, on alluvial fans, in arroyos, and on grassy slopes, sometimes common.

Greene's type is from Guadalupe Island ("isotypes" GH, UC). Johnston (1925:48) also cited Guadalupe collectons by Anthony, Brandegee, and Palmer.

Harpagonella palmeri A. Gray, Proc. Amer. Acad. Arts Sci. 11:88. 1876.

RANGE. — Southern California to Arizona and central Baja California; Santa Catalina Island.

Palmer found this plant only at the "south end," in low valleys (Watson 1876:118). Howell (1942:152) reported it as only in the middle part of the island, where fairly common. I also have seen it only near the middle of the island: on the east to northeast slopes of El Picacho and in the Comal area south of the cypress grove, at 275 to 900 m, rather scarce but locally common.

Gray (1876b) described the species and the monotypic genus *Harpagonella* from Palmer's Guadalupe Island collection (No. 70, GH). Further, the very distinctive bur of this plant inspired Gray (1876a) to write about kinds of burs in the family. All authors have recognized this genus, and Johnston (1924) in his key kept it under a separate tribal name Harpagonelleae.

ϕ***Pectocarya linearis (DC.)*** Ruiz. & Pav. ssp. ***ferocula*** (I. M. Johnst.) Thorne, Aliso 9:191. 1978.

Pectocarya linearis (DC.) Ruiz & Pav. var. *ferocula* I. M. Johnst., Contr. Arnold Arb. 3:95. 1932.

RANGE. — Central California to central Baja California; Santa Rosa, Santa Cruz, Anacapa, San Nicolas, Santa Catalina, San Clemente, and Cedros Islands; also Argentina.

This plant was first found on the island in 1957. In 1958 Dr. I. M. Johnston verified three of my collections: *M5960* and *6633* from the bed of Esparsa Canyon, and *M6650*, from the valley below the Lower Circus at 850 m. It is now widespread, from Northeast Anchorage to the pine ridge to El Picacho and Arroyo Melpomene. In good years it is common in such places as about the principal spring and in the valley below the Lower Circus. It could scarcely have been so common in earlier years without having been found before. Possibly it was rare before and has spread with the drastic changes in the vegetation of the last century. However, I list it with those west American plants possibly introduced on Guadalupe Island (Table 2).

Pectocarya recurvata I. M. Johnst., Contr. Arnold Arb. 3:97. 1932.

Pectocarya penicillata of Guadalupe Island references.

RANGE. — SE California and Nevada to Sonora and northern Baja California.

Palmer collected this plant with *Harpagonella palmeri*, which he found only at the "south" end, in low valleys (Watson 1876:118). In 1958 Dr. I. M. Johnston wrote me that Palmer's specimen and *Anthony 237*, the only collections of *Pectocarya* he had seen from Guadalupe Island, were both *P. recurvata*. He also verified my collection (*M6594*) from the bottom of Esparsa Canyon, where it was fairly common in 1958. I had also found a single plant on the northeast slope of El Picacho at 550 m (*M6467*). I have not since found it on the island and wonder whether this is just an accident or whether *P. recurvata* has declined at the same time that *P. linearis ferocula* seems to have been increasing.

ϕ***Plagiobothrys acanthocarpus*** (Piper) I. M. Johnst., Contr. Arnold Arb. 3:33. 1932.

Allocarya acanthocarpa Piper, Contr. U. S. Natl. Herb. 22:87. 1920.

RANGE. — Central California to NW Baja California; Santa Cruz Island.

Apparently this plant was collected on Guadalupe Island only in 1958: shallow valley below Lower Circus [?] (*Wiggins & Ernst 107*); uncommon on dry ground on a gentle slope northeast of principal spring at 975 m (*M6659*). (My recollection was that Wiggins and Ernst collected the plant the same place I did.) This seems an improbable place for a plant usually found in vernal pools. Remarkably, Palmer, Greene, and Franceschi not only had visited the area but actually had camped there without finding it — though then there were even shallow pools in the area, which would seem more hospitable to it! However, this is a plant that in some places appears only sporadically, apparently de-

pending on rainfall. I list it (Table 2) with those west American plants possibly introduced on the island.

ϕ***Plagiobothrys collinus*** (Phil.) I. M. Johnst. var. ***californicus*** (A. Gray) L. C. Higgins, Great Basin Naturalist 34:163. 1974.

Plagiobothrys californicus (A. Gray) Greene, Bull. Calif. Acad. Sci. 2:407. 1887.

RANGE. — Central California to NW Baja California.

Howell (1942:152) found this plant only near the barracks. It grows now also in the shallow valley below the Lower Circus and on the plateau near the spring, in some years very scarce but sometimes common. In the wet year of 1978 I also found some with smaller flowers as in var. *gracilis* (I. M. Johnst.) L. C. Higgins, the dried corollas 1.5–6 mm wide, varying from plant to plant. The few mature nutlets seen are small, ± 1.25 mm long.

Like *P. acanthocarpus*, this plant now grows where early collectors would probably have found it had it been there then, though the vegetation was then very different. The question again is whether it could have spread from some other part of the island. However, I list it (Table 2) with those west American plants probably recently introduced.

Cactaceae

NOTE. — For *Pachycereus pringlei* see Excluded Species, p. 168.

Mammillaria blossfeldiana Boed. var. ***shurliana*** (H. E. Gates) Wiggins in Shreve & Wiggins, Veg. Fl. Sonoran Des. p. 1030. 1964.

Mamillaria or *Neomammillaria goodridgii* or *goodridgei* of Guadalupe Island references.

RANGE. — West central Baja California; Guadalupe Island.

Greene (1885:223) found a single specimen, of fair size and in flower, toward the south end of the island. On his second trip Palmer found it common at the south end (Vasey and Rose 1890:24). It is widespread over the mesa at the south end and is on Islote Negro (Plate 1A) and Outer Islet but is rather scarce in the northern part of the island: cliff on north rim of Barracks Canyon at the mouth, 450 m (*M6122*).

Lindsay compared living plants from the island with some from the type locality of *M. blossfeldiana* var. *shurliana* and concluded that they were essentially similar (Lindsay and Dawson 1952). He did note, however, that the island plant had pitted rather than smooth seeds, which sounds like an important difference.

Opuntia prolifera Engelm., Amer. Jour. Sci. Ser. 2, 14:338. 1852.

RANGE. — Southern California to NW Baja California and Isla Cedros; offshore islands except San Miguel and Todos Santos.

Greene (1885:223) found this cholla rather common on precipitous rocky places near the sea on both sides of the island, but especially plentiful near the landing. It occurs from the northeast part of the island and West Anchorage to the south end, generally at low elevations but on sunny slopes above Northeast Anchorage to 600 m.

Campanulaceae

Githopsis diffusa A. Gray var. ***guadalupensis*** Morin, Syst. Bot. 8:465. 1983.

Githopsis specularioides of Guadalupe Island references.

RANGE. — Endemic to Guadalupe Island.

Palmer found this plant abundant at the "middle" and north end of the island, under sage brush and dead branches (Watson 1876:116); he said the flowers were white, turning to blue after gathering. Greene (1885:225) listed it without comment. It is now very rare among rocks under pines and oaks on the northeast ridge: in 1955 two plants were found in fruit (*Kuijt & Miller 1006*) and in 1958 two in flower (*M6613*, *Wiggins & Ernst 43*).

Morin (1983) placed the Guadalupe Island variety in *G. diffusa* ssp. *candida* (Ewan) Morin, whose var. *candida* grows in the mountains of San Diego County, California. She described it as shorter than var. *candida*, usually 4-10 cm tall, with smaller upper leaves, the internodes very short and so the plant densely leafy, the hypanthium shorter and ± 2–3 times rather than ± 5 times as long as wide.

Triodanis biflora (Ruiz & Pav.) Greene, Man. Bay Reg. p. 230. 1894.

Specularia biflora (Ruiz & Pav.) Fisch. & C. A. Mey., Ind. Sem. Hort. Petrop. 1:17. 1835.

RANGE. — Oregon to Mexico and South America; Santa Rosa, Santa Cruz, and Santa Catalina Islands.

Palmer found this plant rare, in the shade of rocks and sagebrush on hillsides in the "middle" of the island (Watson 1876:116). It is still uncommon, among rocks under pines and oaks on the upper northwest slope and also near the barracks and on the grassy slopes above.

Caryophyllaceae

NOTE. — For *Polycarpon depressum* see Excluded Species, p. 169.

****Cerastium glomeratum*** Thuill., Fl. Paris, ed. 2, p. 226. 1799.

RANGE. — Native to Europe; a widespread weed in North America.

This weed was first found on the island in 1958, on the pine ridge (*Wiggins & Ernst 35*). It is now widespread there and on the northwest slope of the island, sometimes lush and abundant under the trees, and is fairly common to the spring and the slope above the barracks at Northeast Anchorage.

****Herniaria cinerea*** DC., Fl. Franc. Suppl. p. 375. 1815.

RANGE. — Native to southern Europe; a rather uncommon and sporadic weed in western North America.

This weed was first found on the island in 1958: on four trips in 1957 I had not happened to see it. In April 1958 we found it at a half dozen places scattered from the principal spring to the mouth of Arroyo Melpomene, mostly just one or a few plants at each place. Only on the slopes of El Picacho was it more common, and that has remained its main stronghold on the island. In 1970 it was common on the northeast side from 500 m to

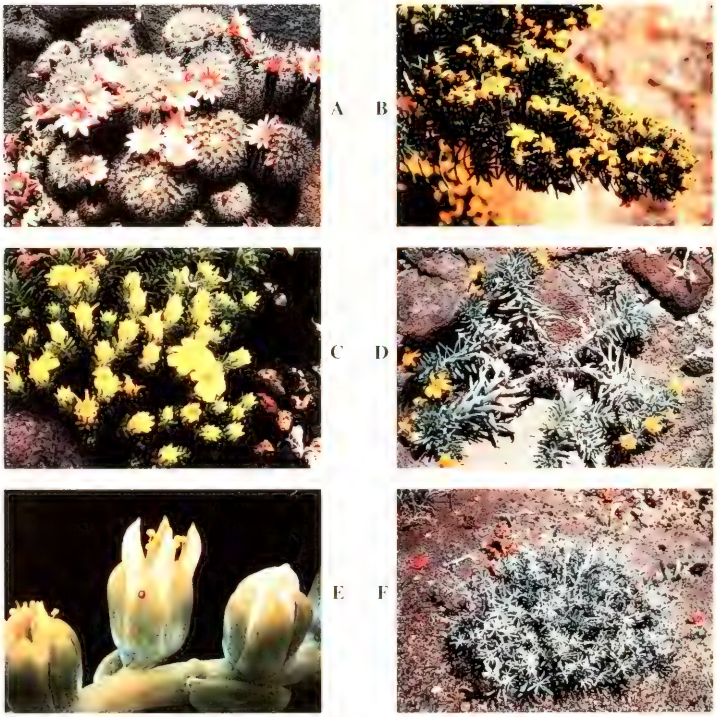


PLATE 1

A. *Mammillaria blossfeldiana* var. *shurliana* (*M67084*) on Islote Negro, 28 April 1958

B. Flowering branch of the endemic *Hemizonia frutescens* (*M29807*) on cliff at the north end at 800 m, 21 August 1981

C. Flowering branch of the endemic *Hemizonia greeneana* ssp. *greeneana* (*M6143*) on the south end mesa at 100 m, 28 October 1957

D. Young plant of the endemic *Hemizonia palmeri* on the south end mesa at 100 m, 27 April 1958

E. Flowers of the endemic *Dudleya guadalupensis* on plant from Islote Negro, grown in San Diego, 6 June 1957

F. The endemic *Lupinus niveus* in arroyo on south end mesa, 29 April 1958

PLATE 2

G. Flowers of the insular endemic *Lavatera occidentalis* (left) and the Guadalupe endemic *L. lindsayi*, on Outer Islet, 11 February 1957

H. The rare endemic *Camissonia guadalupensis* ssp. *guadalupensis* in the bed of Arroyo Melpomene at 450 m (*Moran & Ernst 6737*), 29 April 1958.

I. Young plant of the endemic *Eschscholzia palmeri* on Islote Negro, 19 April 1957

J. Flower of the endemic *Cistanthe guadalupensis* on plant from Islote Negro grown in La Jolla, 30 March 1957.

K. The rare insular endemic *Mimulus latifolius* (*Moran & Ernst 6738*) in the dry sandy bed of Arroyo Melpomene at 450 m, 29 April 1958.

L. The endemic *Triteleia guadalupensis*; a plant of the type collection (*M12063*), from the east base of El Picacho, flowering in San Diego 28 April 1973

the summit and on the south side. Otherwise, it still seems to be scattered.

†***Silene antirrhina*** L., Sp. Pl. p. 416. 1753.

RANGE. — British Columbia to NW Baja California and the eastern United States; San Miguel, Santa Rosa, Santa Cruz, Santa Catalina, San Clemente, and Todos Santos Islands.

Palmer found this plant only in a canyon on the east side, near the beach (Watson 1876:113). No one has found it since, and very likely it is extinct on the island. In other places, however, it appears very irregularly, in some areas commonly following fires. Steve Junak tells me he found it in 1995 on San Miguel Island, where it was seen before only by E. L. Greene in 1886.

****Silene gallica*** L., Sp. Pl. p. 416. 1753.

RANGE. — Native to Europe: a widespread weed in North America.

Palmer found this weed occurring sparingly in the "middle" of the island, in level open spots (Watson 1876:113). It is now widespread and often common on the northwest slope and in the northeast part of the island and less common to the south end.

Spergularia macrotheca (Hornem.) Heynh., Nom. 2:689. 1846.

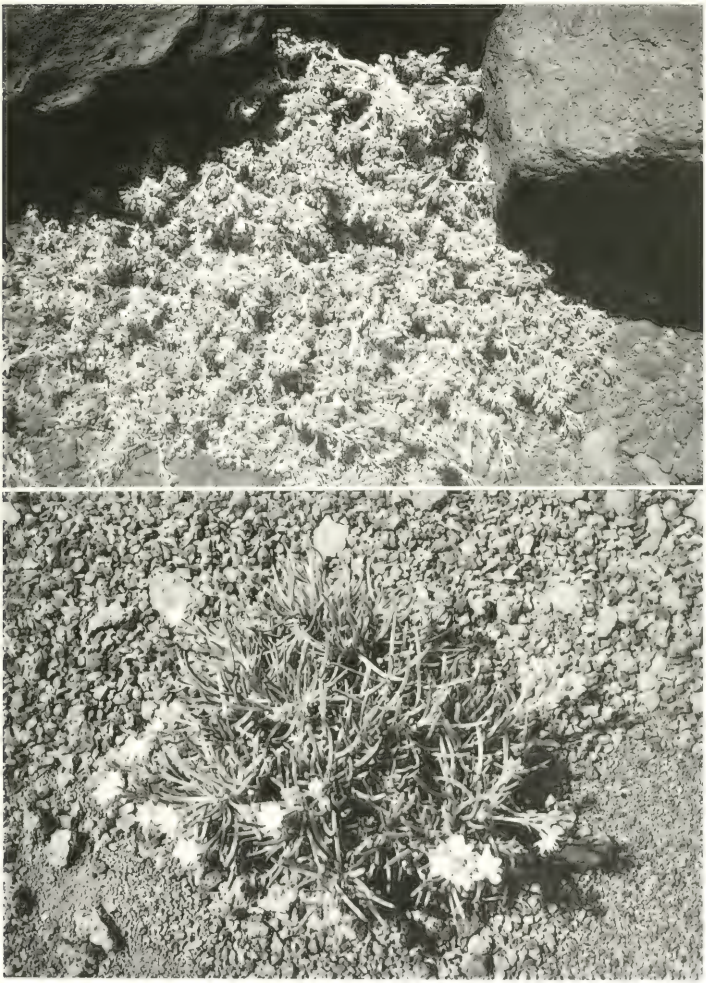
Lepigonum macrothecum (Hornem.) Fisch. & C. A. Mey., Ind. Sem. Hort. Petrop. 3:14. 1837.
Tissa macrotheca (Hornem.) Britton, Bull. Torrey Bot. Club 16:129. 1889.
Tissa talinum Greene, Erythea 1:106. 1893.
Spergularia macrotheca (Hornem.) Fisch. & C. A. Mey. var. *talinum* (Greene) Jeps., Fl. Calif. 1:493. 1914.
Tissa pallida of Guadalupe Island references

RANGE. — Washington to NW Baja California; islands of southern California and Los Coronados.

On his second trip Palmer found this plant common on exposed sides of hills, in arroyos, and on sides of canyons at the south end (Vasey and Rose 1890:23). Franceschi (1893c:134) saw it only on a perpendicular cliff on the right bank of the canyon not far from the landing, growing there in numbers. In the northern part of the island it survives only on cliffs, though sometimes locally common: northwest cliff at 600 m (*M17280*); Barracks Canyon at 480 m (*M7832*); Esparsa Canyon at 300 m (*M6126*). At the south end it grows not only on seacliffs and on Islote Negro and Outer Islet but also commonly on flat areas on the mesa. At the southwest corner of the island it extends far out onto barren lava often exposed to salt spray (Fig. 45).

Greene (1893) based *Tissa talinum* on the collections of Palmer and Franceschi from Guadalupe Island (type: *Palmer 864a*, ND, UC, US). He said it was most unlike all others in its almost obsolete internodes and consequent dense leafiness; and he described the seeds as minute and wingless. To *Spergularia macrotheca* var. *talinum*, Jepson (1915:493) also referred specimens from San Clemente Island.

Rossbach (1940:70–76) discussed in detail the great variation in *S. macrotheca*, seen even in plants growing side by side. She wrote that at first there seemed some reason to keep *Tissa talinum* of Guadalupe Island as an entity because of its extremely short-internoded habit and crowded, spreading, fleshy leaves, with a leafless strict inflorescence standing definitely above the foliage (Fig. 46; also see Moran 1959, fig. 20). As she then pointed



FIGURES 45 and 46. Two forms of the polymorphic *Spergularia macrotheca*. FIGURE 45. A prostrate form (*M13758*), on barren lava near the upper limit of salt spray at the southwest corner of the island, 30 April 1967. FIGURE 46. A form with crowded succulent leaves and with flowers raised above the leaves (*M5659*), in the crater of Outer Islet, 11 February 1957. E. L. Greene named this form as the endemic *Tissa talinum*.

out, however, not all Guadalupe specimens have this habit: she mentioned variation in inflorescence and in size, shape, and pubescence of leaves. Later collections show more variation. In plants of shaded cliffs the stems are pendent and to 7 dm long — longer than she described for the species as a whole. Internodes are to 13 mm long. Leaves are 1–8 cm long, whereas she described them for the species as to 5 cm long. She described the petals for the species as rosy to light pink and perhaps occasionally white but noted that she had never seen any absolutely white in the field; but in five of my Guadalupe collections the color is noted as white and in only one noted as tinged lavender. Rossbach then wrote that the seeds of Guadalupe plants measured 0.5–0.7 mm long, whereas those of *S. macrotheca* are usually 0.7–0.9 mm long but may be only 0.6 mm; in plants of San Clemente Island she found the seeds 0.6–0.9 mm long. She concluded that although some Guadalupe plants have no match in habit elsewhere, *Tissa talinum* is not consistently distinct in any character, and she gave it no taxonomic recognition.

For the plants of San Clemente Island, Raven (1963:321) found that those collected late in the season tend more to approach the form of *T. talinum*. He suggested that the complex needed more study, especially in the experimental garden, since the plants vary so widely in their ecology in nature and probably also show seasonal variation. My seed measurements of more recent Guadalupe collections agree with Rossbach's.

ϕ***Spergularia marina*** (L.) Griseb., Spicel. Fl. Rumel. 1:213. 1843.

RANGE. — British Columbia to NW Baja California and east coast; Santa Rosa, Santa Cruz, Anacapa, San Nicolas, Santa Barbara, Santa Catalina, and San Clemente Islands; also Eurasia.

Howell (1942:149) was first to report this plant, finding it only on the trail to the cypress grove. It has since been found only in the northeast part of the island, as at Northeast Anchorage, near the principal spring, and in the valley below the Lower Circus, sometimes locally common. Because earlier collectors did not find it, the question is whether it could have spread from some other part of the island with the drastic changes at the end of the last century. Raven (1963:298) noted it as possibly introduced on Guadalupe, and I list it with those west American plants probably introduced (Table 2).

Stellaria nitens Nutt. in Torr. & A. Gray, Fl. N. Amer. 1:185. 1838.

RANGE. - British Columbia to Utah and NW Baja California; Santa Rosa, Santa Cruz, and Santa Catalina Islands.

Palmer found this plant among rocks on hillsides in the "middle" and at the north end of the island (Watson 1876:113). Greene found it only under oak trees at the north end. It is now rather scarce, but in small colonies, in open areas from the northwest slope to the cypress grove, at 600–1150 m.

Chenopodiaceae

Aphanisma blitoides Nutt. ex Moq. in A. DC., Prod. 13^2:54. 1849.

RANGE. — Coastal southern California to west central Baja California and offlying islands, except San Miguel.

First to find this plant on Guadalupe Island was Brandegee (1900:22), without specific

locality. It is fairly common on rocky slopes near the shore in the southern part of the island, from Juniper Canyon and West Anchorage to the south end, and on Islote Negro and Outer Islet. It seems remarkable that Palmer did not find it at the south end in 1889, and I wonder if it could possibly be a late arrival.

Atriplex barclayana (Benth.) A. Dietr., Syn. Pl. 5:537. 1852.

Atriplex palmeri S. Watson, Proc. Amer. Acad. Arts Sci. 11:146. 1876.
Atriplex dilatata Greene, Pittonia 1:264. 1889.
Atriplex rosei Standl., N. Amer. Fl. 21:60. 1916.
Atriplex barclayana (Benth.) A. Dietr. ssp. *palmeri* (S. Watson) H. M. Hall & Clem., Carnegie Inst. Wash. Publ. 326:315. 1923.
Atriplex barclayana (Benth.) A. Dietr. ssp. *dilatata* (Greene) H. M. Hall & Clem., Carnegie Inst. Wash. Publ. 326:315. 1923.

RANGE. — Baja California, Sonora, and Sinaloa.

Palmer found this plant only at the "south end" of the island (No. 83; Watson 1876:119). He called it one of the three characteristic perennials of the island, much more frequent than *Artemisia californica* but scarcely half so abundant as *Franseria* [= *Ambrosia*] *camphorata*. It is still very common in the southern half of the island below 600 m (Fig. 32), which is about the level at which the goats totally destroy it. It is also on Islote Negro and Outer Islet (Fig. 35). At the south end in August 1970 I noted this and *Hemizonia greeneana* as the only plants looking much alive at that season.

Watson based *A. palmeri* on *Palmer 83* of 1875 (GH). Greene based *A. dilatata* on specimens from the San Benito Islands. Standley based *A. rosei* on part of *Rose 16022* (US638110), from Guadalupe Island, March 2, 1911.

In their careful revision of *Atriplex*, Hall and Clements (1923:313) stated: "Eight species have been described from what is here included under *A. barclayana* . . . . After assembling all of the available material, it seems doubtful if any of these, with the possible exception of *A. lurida*, can be advantageously retained even as subspecies. Much individual variation is apparent and single plants very frequently have fruiting bracts of two or more of the 'species'. However, the differences between the extremes are so striking that it seems desirable to give some kind of taxonomic recognition to the more frequently recurring forms." Accordingly, they recognized six subspecies, mostly with considerably overlapping ranges. Plants from the southern part of Guadalupe Island they referred to two subspecies: ssp. *dilatata* (including *A. rosei*) and ssp. *palmeri*. Howell (1942:148) noted some variation in habit and vesture, and considerable variation in size and shape of fruiting bracts, but regarded all five of his collections as belonging to a single variable entity. I agree. Whatever the ultimate best treatment of this species, it does not seem feasible to recognize two subspecies occurring together on Guadalupe Island.

ϕ***Atriplex californica*** Moq. in A. DC., Prod. 13^2:98. 1849.

RANGE. — Central California to NW Baja California and Isla Cedros; islands of southern California.

Howell (1942:48) found this plant on an ocean bluff near Northeast Anchorage. Moran (1951:54) found it on the north outer slope of Outer Islet, where also it has been seen later. These are the only known localities on the island. Because earlier collectors did not find it at the principal landing, the question is whether it was a relatively recent arrival; and I list it as possibly so (Table 2).

NOTE. — **Chenopodium ambrosioides* L., "Epazote", grown in a pot at Campo Sur in 1971 (*M29799*), seemed a potential weed, as on Isla Socorro.

Chenopodium murale L., Sp. Pl. p. 219. 1753.

Chenopodium album of Guadalupe Island references?

RANGE. — Native to Europe, a common weed in North America.

Greene (1885:227) found a few plants of this weed near the landing and said it was evidently a newcomer. It is now widespread on the island, from the pine ridge and northwest slope to West Anchorage and Islote Negro, in the northern part of the island sometimes locally common.

Palmer found one plant near the sea on the east side which Watson (1876:227) reported as *C. album* L., but according to Wallace (1985:101) the NY specimen is *C. murale*. Greene (1885:227), while listing *C. murale* as a new arrival, also listed *C. album* without comment; and his specimen, if any, has yet to be checked. Eastwood (1929:403) cited a collection of Hanna and Slevin as *C. album*, but I have not found this at CAS. If *C. album* ever has been on the island, it clearly has not become well established and persisted there.

Suaeda taxifolia (Standl.) Standl., Field Mus. Bot. Ser. 8:10. 1930.

Suaeda californica S. Watson var. *pubescens* Jeps., Fl. Calif. 1:447. 1914.
Suaeda californica, *S. fruticosa*, and *S. torreyana* of Guadalupe Island references

RANGE. — Southern California and Baja California; islands of southern California and also Los Coronados and San Martin.

Palmer saw suaeda on his second trip: Vasey and Rose (1890:22) mentioned it among plants that "have very recently gained a foothold here," although they did not include it in the list of plants collected. It is fairly common at West Anchorage on the flat behind the beach at 10 m and at Campo Sur on the talus at the base of the cliffs and out onto the barren lava flat to the west.

Compositae

†ϕ***Agoseris heterophylla*** (Nutt.) Greene, Pittonia 2:178. 1891.

Troximon heterophyllum (Nutt.) Greene, Bull. Torrey Bot. Club 10:88. 1883

RANGE. — British Columbia and Idaho to NW Baja California; Santa Rosa Island.

Greene (1885:225) found fine large specimens in grassy ground about the springs. There is no further record of this plant from the island, and presumably it is extinct. Greene wrote that this was "of the ordinary form only", and Quentin Jones annotated Greene's specimen of 20 April 1885 (DS) as *A. heterophylla* var. *heterophylla*. Because Palmer had camped for 15 weeks at the springs and had failed to find this plant and three others later found there by Greene, it very likely was a new arrival not well established by Palmer's time. I therefore list it with the west American plants probably introduced on the island (Table 2).

Amblyopappus pusillus Hook. & Arn., Hook. Jour. Bot. 3:321. 1841.

RANGE. — Coast and offlying islands of south central California to central Baja California; also Peru and Chile.

Palmer found this plant in low ground at the "southern end" (Watson 1876:116). It is often abundant on flats and hillsides at low elevations in the southern part of the island, including Islote Negro, less common northward, and rare at high elevations in the north.

Ambrosia camphorata (Greene) W. W. Payne, Jour. Arnold Arb. 45:414. 1964.

Franseria camphorata Greene, Bull. Calif. Acad. Sci. 1:192. 1885.
Franseria bipinnatifida of Guadalupe Island references.

RANGE. — Baja California, including Cedros Island, western Sonora, and southern San Luis Potosi.

Palmer found this one of the most conspicuous plants at the "south end", especially about Jacks Bay [West Anchorage], growing in thick roundish clumps about a foot and a half high on level spots and among rocks, giving the country a greenish white appearance. He added that it was not relished by goats but that asses were very fond of it. In the northern part of the island, even if not relished, *A. camphorata* is now rare and confined to cliffs: north rim of Barracks Canyon near the mouth at 370 m (*M7842*); Barracks Canyon at 300 m (*M7828*); north side of Esparsa Canyon at 300 m (*M6627*); north side of South Esparsa Canyon at 280 m (*M6601*). In the southern half of the island it is dominant in many areas below 500 m. On the southeast coast it is by far the commonest perennial, giving a grayish color to the landscape. On the northeast flank of El Picacho it extends to about 500 m, and just to the north I saw a few seedlings to 600 m. In this part of the island in December 1957 it was little browsed by goats at sea level but showed more and more damage at higher elevations, the upper limit perhaps being the level of total destruction. Similarly, Howell (1941b:40) told how in coming south from the cypress grove he first found the dead remains of franseria, then a few live stumps, and still farther south [and lower] some shrubs a foot or two tall. However, on the uplands south of El Picacho, at about 500 m, some abrupt discontinuities on comparatively level places apparently are due to differences in soil. From there south on the Melpomene drainage, this plant is abundant down to about 250 m but is rarely seen much below, except for a few at the mouth of Arroyo Melpomene. Near Plaza de Toros it is common on the east slope of the island but stops abruptly near the divide with the Melpomene drainage. It is not found on the islets.

Greene based the species on his collections from Guadalupe and Cedros Islands. Payne (1964:415) called the Guadalupe collection the type (holotype CAS; K, NY, US).

Artemisia californica Less., Linnaea 6:523. 1831.

RANGE. — Central California to NW Baja California; islands of southern California and Los Coronados, Todos Santos, and Cedros.

Palmer found this shrub in considerable abundance at the "south end", in rocky spots, giving character to the vegetation, about a foot and a half high, of rather loose habit; also in the "middle" of the island, in crevices of the highest cliffs (Watson 1876:116). He said it was immune to goats and [after the ambrosia and atriplex] one of the three most characteristic perennials of the island (Safford MS). Franceschi (1893c:136) found it in considerable numbers on the cliff east of the cabins [i.e. the Lower Circus] and also a mile

or so to the north. Later collectors have not mentioned it, and it seems to be very rare now, confined to cliffs in the northeast part of the island, if indeed it survives at all. The only collection in this century was in 1957, from a single shrub at 300 m on a cliff in Esparsa Canyon (*M6128*); I failed to find it there the next year. In 1981 I tentatively identified with this species a plant seen high out of reach on a south-facing cliff at 750 m, south of the old lookout and thus high above Northeast Anchorage. This may be the second place mentioned by Franceschi.

Baeriopsis guadalupensis J. T. Howell, Leafl. W. Bot. 3:153. 1942.

RANGE. — Endemic to Guadalupe Island.

This is a dense woody shrublet to 3 dm high and 9 dm wide, having bright green succulent leaves and solitary yellow heads 1–3 cm wide, with mostly 8 rays. For a full description and photographs, one in color, see Moran 1968.

Howell (1942:153) found only a single plant of this species, with *Hemizonia palmeri* and *Sphaeralcea palmeri*, on a rocky flat at the south end of the island. Although rare in such places, accessible to goats, it is common on Islote Negro (Fig. 47), Middle Islet, and Outer Islet and in some other places protected from them. In fact, it very likely is common in many such places along the west and north shore, sheltered by high cliffs above. On rocks occasionally exposed to salt spray, as on the west side of Islote Negro, it grows down close to the sea where little else will grow. In April 1967 it was luxuriant for perhaps a half kilometer along the talus of a north-facing seacliff, and up to the edge of the mesa at 100 m, around the corner just north of Campo Sur (*M13760*); but in August 1981 plants there showed severe damage by goats. In 1988 it was thriving there at the top of the cliff beside the road just above Campo Sur. It also grows at 600 m on ledges on the foggy sheer northwest cliff of the north ridge of the island (*Moran & Philbrick 29592*).

With his new species Howell proposed *Baeriopsis*, a monotypic genus that is thus endemic to Guadalupe Island. He wrote that its affinities were not evident, but he said the characters of involucre, achenes, and pappus seemed to relate it to *Amblyopappus* Hook. & Arn. Carlquist (1959b, figs. 7, 8) studied the wood anatomy of this plant in comparison with various other Helenieae. He also made a chromosome count of $n = 8$ based on his collection *468* (CAS, RSA).

***Centaurea melitensis** L., Sp. Pl. p. 917. 1753.

RANGE. — Native to the Mediterranean region; a widespread noxious weed in western North America and elsewhere.

On his second trip Palmer reported this weed as introduced on the north end and gradually finding its way up the island (Vasey and Rose 1890:25). It is now established at a few places in the northeast part of the island, as at Northeast Anchorage and near the mouth of Esparsa Canyon, and on the east slope of El Picacho at 450 m (*M6751*).

Coreopsis gigantea (Kellogg) H. M. Hall, Univ. Calif. Publ. Bot. 3:142. 1907.

Leptosyne gigantea Kellogg, Proc. Calif. Acad. Sci. 4:172. 1872.

RANGE. — Coast and islands of southern California; Guadalupe Island.

Palmer found only two plants of this species, in the crevices of high rocks (Watson

1876:115); and no one has since found it on the main island. Moran (1951:159) reported it from the sheer cliffs of Inner Islet and common on the floor and inner slope of the crater on Outer Islet (Fig. 48). In 1982 Robert L. Brownell, Jr., of the U. S. Fish and Wildlife Service, sent me photographs (SD 110590) of the cliffs about half a mile north of Pillar Point, on the southeast coast, showing plants which he thought might be *C. gigantea*. I could not be sure from the photographs, but the colors of foliage and flowers strongly suggest *Peritvle incana*.

†***Eriophyllum lanatum*** (Pursh) James Forbes var. ***grandiflorum*** (A. Gray) Jeps., Fl. W. Mid. Calif. p. 524. 1901.

Bahia lanata var., and evidently *Eriophyllum caespitosum*, of Guadalupe Island references.

RANGE. — SW Oregon and north central California as far south as Mariposa County; Guadalupe Island.

Palmer found a single plant that had escaped the goats, on a rocky open spot in the "middle" of the island (Watson 1876:116). Constance (1937:91) described Palmer's specimen and compared it with other collections, saying it was fairly well matched by such specimens as *H. M. Hall 10147* (DS, UC), from Rocklin, Placer Co. He found nothing sufficient to separate it from var. *grandiflorum*. However, Palmer described the flowers as light orange, whereas the rays of this species are always described as yellow.

Franceschi (1893c:135) reported *Eriophyllum*, a woody perennial on a rock near the cabins. Probably this is the same, but Dr. Constance was unable to find Franceschi's specimen at UC, where presumably it should be.

No one has since found this plant, and it probably is extinct on the island.

Filago arizonica A. Gray, Proc. Amer. Acad. Arts Sci. 8:652. 1873.

RANGE. — Southern California to Arizona, central Baja California, and northern Sonora; Santa Catalina, San Clemente, and Cedros Islands.

Palmer found this plant on level ground at the "south end" (Watson 1876:115). Howell (1942:154) found it on the slope of the pine ridge as well as farther south. Mostly it grows in the southern part of the island, sometimes locally common, but generally little collected. Dr. James Morefield verified two of my collections in 1992.

ϕ***Filago californica*** Nutt, Trans. Amer. Phil. Soc. Ser. 2, 7:405. 1841.

RANGE. — Northern California to Utah, Texas, Sonora, and central Baja California; islands of southern California except San Nicolas; also Todos Santos and Cedros.

Greene (1885:224) found a fine growth of this plant about the springs, and Franceschi (1893c:135) called it very plentiful. It is widespread on the island, from the pine ridge to Arroyo Melpomene, and is more common than the other species. Dr. James Morefield verified nine of my collections in 1992.

Because Palmer had camped at the springs for 15 weeks without finding this plant, as well as three others that Greene found there ten years later, and because it is now widespread and common and impossible to overlook, very likely it was a late arrival and not well established by Palmer's time. I therefore list it with the west American plants probably

Fig. 46. A specimen and plant of *Argemone pleiacantha* subsp. *ambigua* (Ownbey & Thorne) G.B. Ownbey & Morefield (Moran 27524) on Isabela, Negros, showing the characteristic leaves and the flowers and buds. 18 April 1970. This is *Argemone ambigua* Ownbey & Thorne, published in 1948.

Fig. 47. Developing plants of *Argemone pleiacantha* subsp. *ambigua* on the crater of Quezal Volcano, Isabela, Negros, at 1,200 m elevation. Moran 27524. 18 February 1987. Beyond the lava crater rim are Mounts Silay and Inayawan, and beyond them the south and the west coasts of Negros.

introduced on the island (Table 2).

Gnaphalium bicolor Bioletti, Erythea 1:16. 1893.

RANGE. — Central California to southern Baja California; islands of southern California and Todos Santos, San Martin, and Cedros.

I first found this plant on the island in 1958. It seems to be local below 400 m on the east side of the island, in Esparsa Canyon (*e.g. M13793, M18153*) and in Long Canyon (*M12077*). It is rather infrequent in a part of the island where no early botanist but Brandegee is known to have collected. Possibly it is a recent arrival, but the evidence is not convincing.

Gnaphalium stramineum Kunth, Nov. Gen. Sp. 4:85. 1820.

Gnaphalium chilense Sprengel, Syst. 3:480. 1826.
Gnaphalium sprengelii Hook. & Arn., Bot. Beechey Voy. p. 150. 1833.

RANGE. — Washington to Montana, Texas, and northern Baja California and Isla Cedros; islands of southern California except Santa Barbara and San Clemente.

Palmer collected this with *Microseris* in the "middle" of the island (Watson 1876:116), Greene (1885:224) found only one, and Palmer on his second trip found three plants in an arroyo bed at the south end (Vasey and Rose 1890:24). I have seen only a few plants in the bed of Arroyo Melpomene near the mouth, in 1958 (*M6715*) and again in 1970 (*M17350*).

Haplopappus canus (A. Gray) S. F. Blake, Contr. U. S. Natl. Herb. 24:86. 1922.

Diplostephium canum A. Gray, Proc. Amer. Acad. Arts Sci. 11:75. 1876.
Corethrogyne cana (A. Gray) Greene, Bull. Calif. Acad. Sci. 1:223. 1885.
Hazardia cana (A. Gray) Greene, Pittonia 1:29. 1887.

RANGE. — Endemic to San Clemente and Guadalupe Islands.

Palmer found this shrub in the crevices of high cliffs (Watson 1876:115). Greene (1887:29) could find but a single specimen, in a niche some 20 feet above the base of a perpendicular cliff near the summit of the island. He supposed this shrub the only survivor, and it seemed in the decline of old age. Franceschi (1893c:135) also saw only one, perhaps the same one, on the cliff of the Lower Circus near the corral.

Despite Greene's gloomy words, however, I have seen a score of survivors in the last 40 years, on several cliffs in the northern part of the island: one in 1957 on the north rim of Barracks Canyon near the mouth at 450 m (*M6120*); nine in 1970 on the south side of Esparsa Canyon at 250 m (*M18151*); one in 1970 on the pine pinnacle at the north end, at 550 m; one in 1971 near the middle of the north end, at 675 m; four in 1981 in Oak Canyon and on the Lower Circus at 850 m (*M29804*); five in 1981 on a western cliff northwest of the cypress grove at 1075 m. However, I have not seen seedlings, and the small total number still suggests endangerment.

Palmer found the plant in flower March 28, but I found the best flowers in August (*M29804*) and poorer remnants in April, May, and October.

Gray (1876:75) based the species on *Palmer 39*, from Guadalupe Island (holotype GH; F, MO, NY). Although Hall (1928:244) treated *Hazardia detonsa* (Greene) Greene, of Santa Rosa and Santa Cruz Islands [and Anacapa], as a synonym, he discussed differences

and suggested that with more information it might be restored. With more collections, Raven (1963:343) elaborated the differences and separated the northern plant as *Haplopappus detonsus* (Greene) Raven.

Hemizonia

NOTE. — For *H. streetsii* see Excluded Species, p. 169.

Two species and one subspecies of *Hemizonia* are endemic to Guadalupe Island. These three belong to a group informally called Section *Zonamra* by Keck (e.g. 1960:172), with six shrubby species having much reduced upper leaves. The others are *H. clementina* Brandegee on six of the Channel Islands of California, *H. streetsii* A. Gray of the San Benito Islands of Baja California, and *H. minthornii* Jeps. of the Santa Susana Mountains and Santa Monica Mountains of southern California. Carlquist (1959a) studied the wood anatomy of this group in comparison with other Madiinae. And Carlquist (1965:115–118) discussed and illustrated them as an example of adaptive radiation. Bruce Baldwin is growing the three Guadalupe species plus *H. clementina* and *H. minthornii* and tells me he has fertile hybrids in all combinations, the three Guadalupe species completely interfertile. On the island, *H. frutescens* seems geographically distinct, high on the north end. The other two grow together at the south end, where they look quite distinct and different; but their flowering times overlap and they do hybridize, though rarely.

Hemizonia frutescens A. Gray, Proc. Amer. Acad. Arts Sci. 11:79. 1876.

RANGE. — Endemic to Guadalupe Island.

Small sparse shrub, with stem to 1.5 cm thick, having thin brown bark splitting lengthwise, and with branches few, erect to arching or decumbent, slender, 4–8 dm long; or according to Greene flowering while still herbaceous. Stems sparsely glandular and hirsutulous to closely hirsute with uniseriate trichomes to 2 mm long, later with axillary cottony tufts; axillary fascicles starting above during first year, those in upper 10 cm later growing out as closely glandular branchlets to 5 cm long, each with terminal head and with tertiary branchlets to 1.5 cm long in upper 1–2 cm; these sometimes with a few short quaternary branchlets. Primary leaves linear, thick-margined, 2–8 cm long, 1–5 mm wide, hirsute and glandular, mostly with 3–4 ascending teeth; secondary linear, entire, 1–2 cm long, closely glandular; upper fasciculate, filiform, 2–4 mm long. Flowering mainly in summer; heads thyrsoid-racemose; involucres 3–5 mm high and wide, short hirsute and glandular; ray florets 8–9, the ligules obovate-oblong, 2–3-toothed, 3–4 mm long; disk florets 10–12, the group surrounded by as many nearly discrete linear bracts; pappus of 5 linear or subulate fimbriate-denticulate paleae, the disk achenes well-formed but apparently sterile. Mature achenes?

Palmer found only a few small plants among bushes in the crevices of high rocks in the "middle" of the island (Watson 1876:115). Greene (1885:224) found it common on level ground and hillsides, in such places strictly annual, and saw only one suffrutescent plant, on a precipice. Today it is fairly common, as a small shrub, at 500–800 m on cliffs at the north end of the island (Fig. 49), from North Point at least to the middle of the north end. Also, I thought I saw it on westside cliffs at 1075 m, northwest of the cypress grove. Palmer found abundant yellow bloom on May 1. I found no flowers in December, April, or one May, only one plant with a few flowers another May (*M13813*), and all plants in good flower in August (*M29807*) (Fig. 49, Plate 1B).

Hemizonia greeneana Rose ssp. ***greeneana***

Hemizonia greeneana Rose in Vasey & Rose, Contr. U. S. Natl. Herb. 1:24. 1890.

RANGE. — Endemic to the south end of Guadalupe Island and offlying islets.

Dense compact rounded dark green moundlike shrub to 8 dm high and 2.4 m wide, with arching-decumbent branches (Figs. 33, 50), or in exposed places the plant prostrate; herbage glandular-viscid throughout. Branches closely leafy below, only the lowermost leaves opposite, the middle axils often with fascicled leaves, the upper mostly with leafy branchlets; ultimate branchlets or peduncles with shorter internodes and fascicled leaves. Lower leaves often glabrous except for the glands, sometimes sparsely hirsute or villous-hirsute, 2–4.5 cm long, 5–8 mm wide, the rachis 2–4 mm wide, seldom entire, mostly with 4–12 ascending teeth or lobes; upper leaves gradually smaller, entire, those of the peduncles linear-oblong, ± 5–10 mm long and 0.5–1 mm wide. Flowering throughout the year but mainly in summer; heads often numerous and subcorymbose on main branches, solitary or few and cymose on branchlets, 11–18 mm wide, mostly 8-rayed, but some early ones with more rays and the first, terminating the main branches, with as many as 14; involucres campanulate, 4–7 mm high, 4–6 mm wide, sparsely hirsute, beset with peg-like glands 0.05 mm long and each tipped with a sticky yellowish globule ± 0.1 mm thick, the bracts lanceolate, acute, cymbiform and strongly keeled in lower 3/5 and ± 2.5 m wide (flattened), with hyaline margins, narrowed to a flatter thickish apex 2–3 mm long; ray florets 8–14, the tube 1.5–2.5 mm long, stipitate-glandular, the ray oblong to obovate, truncate and 2–3-crenate at apex, 4.5–6.5 mm long, 2.5–3.5 mm wide, subglabrous, the style branches slender, 2–3 mm long; receptacular bracts 8–13 (about as many as rays), in one series, weakly united to middle or above, oblanceolate, narrowly acute, 5–6 mm high, ± 1.5 mm wide, herbaceous with hyaline margins, glandular, the apex sparsely long-ciliate; disk florets 8–14 (–21), the corollas 4–5 mm long, the tube slightly ampliate above, subglabrous, the lobes triangular-ovate, 0.7–1.0 mm long, thickened and densely puberulent ventrally on margins, the anthers yellow, ca. 2.5 mm long, the stigma lobes 2 mm long, the achenes sterile, 1.7–2.5 mm long, sparsely glandular-puberulent, the paleae 6–11, 1.3–2.4 mm long, free or united at base, unequal, irregularly lanceolate or oblong, stiff, dull white, subentire to laciniate. Achenes 2–3 mm long, triquetrous, black, transversely rugose, acute and stipitate at base, with upcurved beak mostly 2–3 times as long as thick.

On his second trip, Palmer found this shrub common on the south end, in all the canyons and arroyos and along the beach: he called it a very homely plant, growing in great clumps in barren places and the most noticeable plant of the region (Vasey and Rose 1890:24). Because of its size and dark foliage, it is indeed the most conspicuous plant of the south end; and it flowers abundantly in summer, making a beautiful show when other plants are dormant. Along Arroyo Melpomene it extends only ± 3 km from the south end, to 350 m. However, in April 1970 I saw what seemed to be *Hemizonia*, probably of this species, on the western seacliffs a little farther north. It also grows on the east slope of the island north of Morro Sur (*Junak 2069*). It is common on Islote Negro, Middle Rock, and Outer Islet; and in August 1970 I saw many plants in full flower on the sheer south face of South Bluff. Thus it is abundant but very restricted at the south end of the island.

The ssp. *peninsularis* Moran (1969:286) is a slightly taller and mostly more open shrub, with mostly virgate branches, generally shorter and stiffer trichomes, somewhat longer and relatively narrower lower leaves with fewer teeth or lobes, more and slightly longer

FIGURE 49. The endemic *Hemizonia frutescens* (*M29807*) on cliff at the north end, 800 m, 21 August 1981

FIGURE 50. The endemic *Hemizonia greeneana* ssp. *greeneana* at the south end—old shrubs, showing the arching branches; 27 April 1958. This shrub is local but abundant on the south end and its islets and makes a beautiful show with yellow flowers in summer, when other plants are dormant

pappus paleae, and generally shorter beak on the achene; however, both are variable. It is very local in northwest Baja California, on the Todos Santos Islands, on Punta Banda, and on north-facing cliffs at the mouth of the Río San Miguel. Brandegee (1899) first reported the Todos Santos Island plant as seeming the same as specimens from Guadalupe Island that were named as *H. frutescens* but that did not exactly agree with the description of that species; later (1900) he called the Todos Santos plant *H. greeneana*.

Rose described the heads of *H. greeneana* as having 8 rays and 8–10 disk florets, as in *H. frutescens* and *H. palmeri*, and at most seasons they do (Plate 1C). However, early heads, ending the main branches, may have 12–14 rays, a corresponding number of involucral and receptacular bracts, and a correspondingly large number of disk florets, sometimes as many as 21. These early heads resemble the usual heads of *H. clementina* Brandegee, of the Channel Islands, which regularly have 12–14 rays and 15–30 disk florets but which differ in having 2 series of receptacular bracts. As the leaves of the two also are similar, *H. greeneana* ssp. *peninsularis* in early flower has been mistaken for *H. clementina*. Of the other two species of sect. *Zonamra*, *H. streetsii* A. Gray, of San Benito Islands, has 11–31 rays and 50 or more disk florets, and *H. minthornii* Jeps., of the southern California mainland, has 8 rays, 18–23 disk florets, and receptacular bracts in ± 3 series. I wonder about the number of rays in first heads.

Hemizonia palmeri Rose in Vasey & Rose, Contr. U. S. Natl. Herb. I:24. 1890.

RANGE. — Endemic to the south end of Guadalupe Island.

Flattened shrub, 0.5–1.5 (–2.5) dm high and 3–6 (–8) dm wide, the woody main stem to 2.5 cm thick; herbage with abundant white silky pubescence. Leaves numerous, opposite below, linear to narrowly oblanceolate, mostly entire, silky strigose, not at all viscid, 1–2 cm long, 1.5–3 mm wide. Flowering in winter and spring; heads numerous, somewhat corymbose; involucral bracts 4–4.5 mm long, each entirely surrounding achene, hyaline margined; rays 8, the corolla 4.5 mm long including tube, the tube ± 0.7 mm long, villous; receptacular bracts 8, very weakly united ± to middle, the divisions linear-acuminate, with prominent midvein, pilose to base, the apex ciliate; disk florets 10–12, the corollas 3–3.5 mm long, the lobes lightly villous, the disk achenes 1.2–1.6 mm long, flat, sterile. Achenes 1.7–2.2 mm long, the beak short, appressed to body; paleae 6–12, very unequal, 1.1–2.7 mm long. (Plate 1D).

On his second trip Palmer found this a very common plant on the south end of the island, in all exposed places (Vasey and Rose 1890:24). Though less common than the larger and more conspicuous *H. greeneana*, it is well distributed over the mesa, and sometimes locally common, within 3 km of the south end and up to 200 m; it has not been found on the islets. Thus it appears to be highly restricted. It is in full flower in March and April, when *H. greeneana* is mostly not flowering; and it is completely dormant, looking almost dead, in summer, when *H. greeneana* is at the height of flowering. In 1958 I found two apparent hybrids between the two species, one intermediate (*M6694*), the other (*M6695*) more like *H. palmeri*.

****Hypochoeris glabra*** L., Sp. Pl. p. 811. 1753.

RANGE. — Native to Europe; a widespread weed in North America.

Mason found a single plant of this weed in Barracks Canyon in 1925 (Eastwood 1929:417). It now occurs the length of the island and from shore to summit, rather common on the north slope and in some canyon bottoms.

Lasthenia californica DC. ex Lindl., Bot. Reg. 21: sub. pl. 1780. 1835.

Baeria gracilis (DC.) A. Gray, Proc. Amer. Acad. Arts Sci. 9:196. 1874.
Baeria palmeri A. Gray, Bot. Calif. 1:376. 1876.
Lasthenia chrysostoma (Fisch. & C. A. Mey.) Greene, Man. Bot. San Francisco, p. 205. 1894.
Baeria chrysostoma var. *palmeri* (A. Gray) J. T. Howell, Leafl. W. Bot. 3:152. 1942.

RANGE. — Oregon to Arizona and NW Baja California; islands of southern California and Los Coronados, Todos Santos, and Cedros.

Palmer found this plant abundant in warm low spots in the "middle" and at the "south end" (Watson 1876:116), and Howell (1942:152) called it occasional from the middle to the south end. It is widespread in the southern half of the island and as far north as Esparsa Canyon, generally not common but in wet years locally abundant and giving color to some grassy slopes. Ornduff (1966:58) cited the collections of Brandegee and of Wiggins and Ernst. Concerning the accepted name, see Johnson and Ornduff (1978).

Although Palmer had found this plant before, Brandegee (1900:22), without explanation, called it recently introduced. However, it grows also on the northern islands in a familiar pattern, and in all respects it seems like a native on Guadalupe.

Dr. Ornduff, who used Guadalupe seedlings in his hybridization studies (Ornduff 1966), wrote me in 1959 that in the greenhouse they were distinctive for their tallness, wiry stems, and general reluctance to shed their achenes even when ripe.

†****Lasthenia coronaria*** (Nutt.) Ornduff, Univ. Calif. Publ. Bot. 40:76. 1966.

Baeria coronaria (Nutt.) A. Gray, Proc. Amer. Acad. Arts Sci. 19:23. 1883.

RANGE. — Southern California to NW Baja California; Los Coronados and Todos Santos Islands.

Brandegee (1900:22) listed this plant as "a recent introduction about the usual landing" (Northeast Anchorage), though he did not explain further. Since he also called *B. californica* a recent introduction, when that seems clearly native, we cannot accept his statement without knowing his thinking. However, this plant has not otherwise been found on the island, before or since, suggesting that it may then have been a new arrival that never became established. Since every botanist to visit the island has gone ashore at the landing where he found this plant, very likely someone else would have found it had it grown there for long, whether native or not (though it is true that a few rare native plants have been found there only once). Furthermore, there is no particular reason to think it a likely native: it has not reached any of the islands of southern California, all closer to the mainland, though 89 percent of the Guadalupe natives that occur also in cismontane southern California have reached one or more of these islands. Having no reason to disagree with Brandegee's statement, I therefore tentatively accept this species as an introduction that did not become established. Brandegee's specimen was cited by Ornduff (1966:79).

†***Layia platyglossa*** (Fisch. & C. A. Mey.) A. Gray, Mem. Amer. Acad. Arts, Ser. 2, 4:103. 1849.

Layia elegans (Nutt.) Torr. & A. Gray, Fl. N. Amer. 2:394. 1843.

RANGE. — Northern California to central Baja California; San Miguel, Santa Rosa, Santa Cruz, Santa Catalina, and San Clemente Islands.

Both Anthony and Brandegee collected this plant on Guadalupe Island in 1897, with no specific locality. There is no other record, and probably it is extinct on the island. Wallace (1985:50) cited *Anthony 251* at US. The specimen of Anthony's collection at UC was annotated by David Keck in 1934 as *L. elegans*. On the same sheet is a specimen collected 20 March 1897 by Brandegee, labeled *L. platyglossa* A. Gray, and checked by Keck.

†***Malacothrix clevelandii*** A. Gray, Bot. Calif. 1:433. 1876.

RANGE. — California to Utah and extreme northern Baja California; Santa Rosa Island.

Palmer found this plant abundant among rocks and trees in the "middle" of the island (Watson 1876:116). Greene (1885:225) noted it without comment. In revising this group, Davis and Raven (1962:261) noted that the occurrence of *M. clevelandii* on Guadalupe Island needed to be confirmed by more material and by a chromosome count. Apparently, however, no one has found it for over a century, and it probably is extinct on the island.

Matricaria matricarioides (Less.) Ch. Porter, Mem. Torrey Bot. Club 5:341. 1894.

Matricaria discoidea DC., Prod. 6:50. 1837.
Chamomilla suaveolens (Pursh) Rydb., N. Amer. Fl. 34:232. 1916.

RANGE. — Alaska to NW Baja California and NE Asia; Santa Rosa, Santa Cruz, Anacapa, and Santa Catalina Islands.

Palmer found this plant around springs in the "middle" of the island (Watson 1876:116). It was still there, but rare, in 1958 (*Wiggins & Ernst 113*). Although it may still turn up in a good year, quite possibly it is extinct on the island.

The native range of this weedy plant is unknown, and possibly it is introduced on Guadalupe Island.

†***Micropus californicus*** Fisch. & C. A. Mey., Index Sem. Hort. Petrop. 1835:42. 1835.

RANGE. — SW Oregon to NW Baja California; Santa Rosa, Santa Cruz, and Santa Catalina Islands.

Palmer found this plant on dry gravelly slopes in the "middle" of the island (Watson 1876:115). No one has seen it since, and it probably is extinct on the island.

Perityle emoryi Torr. in Emory, Notes Mil. Rec. p. 142. 1848.

Perityle grayi Rose, Bot. Gaz. 15:118. 1890.
Perityle californica of Guadalupe Island references.

RANGE. — Southern California and Nevada to Baja California and Sonora; W South America; islands of southern California and NW Baja California except San Miguel and San Nicolas.

Palmer found this plant scattered through some of the canyons on the east side (Watson 1876:116). It is widespread on the island, from the north slope to the south end and on Islote Negro and Outer Islet, more common at lower elevations and southward.

From Guadalupe Island, Powell (1974:258) cited collections by Anthony, Carlquist, Mason, Moran, Palmer, and Rose. He included here *Perityle grayi* Rose, based on *Palmer 44* of 1875 (US?; isotypes GH, NY) from Guadalupe Island.

FIGURE 51. Old shrub of the endemic *Perityle incana* (*M13792*) hanging from a cliff in Esparsa Canyon, with Fritz Ohre for scale; 2 May 1967.

Perityle incana A. Gray, Proc. Amer. Acad. Arts Sci. 11:78. 1876.

Nesothamnus incanus (A. Gray) Rydb., N. Amer. Fl. 34:12. 1914.

RANGE. — Endemic to Guadalupe Island.

This is a dense grayish-white tomentulose shrub 1–2 or even 4 m wide and sometimes trailing to 5 m (Fig. 51), the stem soft-woody, to 4 cm or more thick, with naked corymbs of 10–50 or more discoid yellow heads.

Palmer found this shrub very common in the "middle" of the island, in the crevices of high rocks, hanging in massive bunches of yellow bloom (Watson 1876:116). Franceschi (1893c:136) called it by far the most abundant of all the shrubs still living on the island and the most likely to survive, as it seemed quite at home on the more precipitous cliffs and young plants and seedlings were abundant in the crevices of the rocks. It is certainly the commonest shrub on the cliffs today (Fig. 28); and on cliffs it extends from sea level

to Mt. Augusta at 1220 m and the length of the island, from the north end to the islets off the south end. On the islets it also grows in less steep places, but Greene (1885:216) did not mention it among the shrubs that in his day still covered the gentler slopes in the north. Nor does it grow on gentler slopes in the southern half of the island where *Ambrosia camphorata* and *Atriplex barclayana* are abundant despite the goats or at the south end where hemizonia thrives. A few seedlings of the perityle appear on slopes below the northern cliffs but persist even briefly only in years of fewer goats. From February to October and probably in the other months at least some plants can be found flowering, but the main flowering period is about April to June.

Gray based this species on Palmer's collection No. 43 (holotype GH; NY, US). This is the shrubbiest member of its genus, and Carlquist (1959b, figs. 1, 2) studied its wood anatomy in comparison with various other Helenieae. It is distinctive also for its tomentulose herbage, rather large naked corymbs, and coarsely pubescent achenes, and it is nearly unique in its discoid heads. Partly because of its shrubbiness, Powell suggested that it might be a primitive member of the genus, but presumably this is an example of insular woodiness. For this species Rydberg (1914) proposed the monotypic and thus endemic genus *Nesothamnus*, returned to *Perityle* by Blake (1926), Everly (1947), Powell (1974), and most other authors. However, Powell wrote that it did not belong to any of the related-species groups and thus stood as an anomalous species. He said that it could, in fact, be recognized as a monotypic genus with little change in the taxonomic naturalness of the subtribe. He added that it was similar to *Pericome* in habit and capitulescence characters and perhaps shared ancestral affinity with that genus. Howell (1942) did recognize *Nesothamnus*. However, Powell suspected that *P. incana* was distantly related to the *P. crassifolia* group and was best treated as a member of section *Perityle*. Based on *M17426* Powell (1974) reported a chromosome count of $n = 50–57$, hexaploid.

Davies (1980) illustrated a plant grown at Kew from seeds from Islote Negro (*M17426*). From seeds from the same source and from later collections, it is also grown now in southern California for drylands plantings.

Senecio palmeri A. Gray, Proc. Amer. Acad. Arts Sci. 11:80. 1876.

RANGE. — Endemic to Guadalupe Island.

Dense white shrub ± 1 m high and (on cliffs) to 1.5 or 2 m wide, much branched from base, with trunk to 1 dm thick. Leaves oblong-spatulate, obtuse, pinnately veined, 2–9 cm long, 0.5–2 cm wide, entire to sinuate-dentate, narrowed at base to a slender petiole. Inflorescence a terminal pedunculate few to several headed corymbose cyme. Heads yellow, on long bracteate peduncles, 10–14 mm high, radiate; involucre white, barely calyculate, of 20–30 linear bracts; ray florets 12–18, the rays oval, 8 mm long; disk florets numerous; achenes sericeous-pubescent.

Palmer called this shrub "white sage" and found it very abundant on many warm spots, from the "middle" to the north end: about three feet high, of diffuse habit, a very free and showy bloomer, beginning to flower early in February and maturing in May, when the air was filled with its downy seeds (Watson 1876:116). Greene (1885:216) found it still covering the gentler declivity leading to the plateau from the zigzag trail out of the canyon; he called it really very handsome, a shrub three or four feet high, with snow-white foliage and fine clusters of yellow blossoms. According to Bryant (1887:271), an ornithologist who spent the first three months of 1886 there, a "small white sagebrush with yellow blossoms" grew in places "throughout the entire length of the island." On his second visit, in 1889, Palmer found that the senecio had decreased, spots where there

FIGURE 52. The endemic *Senecio palmeri* from cliff of the Lower Circus (*M6653*), 25 April 1958. Once the commonest shrub of the northeast part of the island, it survives only on a few cliffs and is becoming rare

were thickets of it before having now only dead plants, with just a few scattering plants alive. Four years later, Franceschi (1893c:136) found it only on the eastern cliff, where he saw perhaps three dozen; he called it very conspicuous and much whiter even than *Perityle incana*. I have seen it only in Oak Canyon and around the corner to the south on the cliffs of the Lower Circus (Fig. 52), where despite the whiter foliage it is sometimes hard to tell at a distance from the much more abundant *Perityle incana*. In January 1960 I saw 12 without having time to cover the length of the cliff. In 1974 I found a young plant in a crevice of the Lower Circus, showing it still does reproduce on the cliff. In August 1981, with older eyes and no field glasses, I failed to identify any, but I am hopeful that they still survive

Carlquist (1962, figs. 26, 27) studied the wood anatomy of this plant in comparison with various other Senecioneae, based on his collection *260*.

****Sonchus oleraceus*** L., Sp. Pl. p. 794. 1753.

RANGE. — Native to Europe; a common weed in North America.

Palmer found this weed very rare, on warm slopes in the "middle" of the island (Watson 1876:116). Greene (1885:225) reported it now very common on the eastward slope of the island. It now extends the length of the island, from the north slope to the south end and on Islote Negro, in some northern areas fairly common.

Sonchus tenerrimus L., Sp. Pl. p. 794. 1753.

RANGE. — Native to Europe; a weed in the SW USA and Mexico.

On his second visit Palmer found this plant in shady canyons at the south end, not common (Vasey and Rose 1890:25). It is now occasional near the shore in the southern half of the island.

Stebbinsoseris heterocarpa (Nutt.) K. L. Chambers, Amer. Jour. Bot. 78:1024. 1991.

Microseris heterocarpa (Nutt.) K. L. Chambers, Contr. Dudley Herb. 4:286. 1955.
Microseris lindleyi of Brandegee's reference.

RANGE. California and NW Baja California; Santa Rosa, Santa Cruz, Anacapa, Santa Catalina, and San Clemente Islands.

Brandegee (1900) reported this plant from Guadalupe Island without comment, and Chambers (1955:288) cited his specimen. It seems to be local on the east side of the island just south of the middle, generally rather scarce but noted in 1970 as fairly common locally on the northeast slope of El Picacho at 525 m (*M17381*) and as occasional in the bed of Long Canyon at 50 m (*M17362*).

†***Stephanomeria diegensis*** Gottlieb, Madroño 21:476. 1972.

RANGE. — Southern California and NW Baja California; Santa Rosa, Santa Cruz, Santa Catalina, San Clemente, Los Coronados, and Todos Santos Islands.

This plant is known from Guadalupe Island only from a collection (no. 46, UC) by W. W. Brown in 1906. Gottlieb (1971) showed a dot for the island on his map for this species. He wrote me that the Brown collection at UC is a poor specimen whose long peduncles suggest *S. exigua* Nutt. ssp. *deanei* (J. F. Macbr.) Gottlieb, to which *S. diegensis* is closest. Dr. Reed Rollins wrote me in 1988 that he did not find a specimen at GH.

Stephanomeria guadalupensis Brandegee, Zoe 5:164. 1903.

RANGE. — Endemic to Guadalupe Island.

Perennial with milky-orange latex, closely white tomentose, sometimes subglabrescent, usually several branched from a woody perennial base to 4 cm thick and with corky bark, the stems often decumbent at base, thence erect, unbranched and leafy below inflorescence, to 1 or even 1.5 m tall and to 2.5 cm thick at base. Leaves oblanceolate to spatulate, acute to rounded at apex, attenuate below to a broad petiole, entire to sinuate-dentate or often deeply pinnatifid into a dozen narrow segments, the lower leaves 0.5–3 dm long, 2–9 cm wide, the upper gradually smaller and becoming entire. Panicle viscid, 1–6 dm tall, 4–20 cm wide, of many ascending racemose branches with heads more crowded at tips, flowering August to October. Involucres 10–11 mm long, glandular, somewhat wooly at apex, with graduated small outer bracts, 5–8-flowered (Fig. 54). Ligules deep pink, + 8 mm long and 3–4 mm wide; anthers 4–5 mm long. Achenes 4 mm long; pappus 4–6 mm long, of 14–19 bristles, plumose nearly to base.

Brandegee collected the type March 26, 1897, in Sparmanns Canyon (perhaps Esparsa Canyon?), where the clumps of white leaves were very conspicuous on the nearly perpendicular dark colored cliffs. The inflorescence with fruiting heads that he collected was a remnant from the previous season (holotype UC92373!). Though not so common as peritvle and galvezia, this showy plant grows on cliffs throughout the island, from the

FIGURES 53 and 54. The endemic *Stephanomeria guadalupensis*. FIGURE 53. Colony on Outer Islet, 21 August 1970. FIGURE 54. Flower head (× 4.5) of plant from Esparsa Canyon (*M6135*) grown in Berkeley, 26 November 1960

FIGURE 55. Young branch of *Stephanomeria guadalupensis* growing up to become a floral stem: the condensed form on Outer Islet (*M15119*), with subentire leaves; 21 June 1968

north end to Outer Islet (Fig. 35). Earlier collectors must have seen it but would not have found it flowering in spring.

On shaded cliffs in the northern part of the island, lower and middle leaves are large and deeply pinnatifid and tend to be glabrescent; for a photograph, see Carlquist (1965, fig. 14-6). On Outer Islet the plant has a very different aspect: more compact, more densely tomentose, with leaves subentire to sinuate-dentate (Figs. 53, 55). This form has been grown at the Santa Barbara Botanic Garden. Plants of exposed seacliffs on the main island (*Howell 8175*, *M6124*) are much like those of Outer Islet.

Carlquist (1960) studied the wood anatomy of this plant in comparison with other Cichorieae.

Uropappus lindleyi (DC.) Nutt., Trans. Amer. Philos. Soc. II, 7:425. 1841.

Microseris linearifolia (Nutt.) Sch.-Bip., Pollichia 22–24:308. 1866.

Microseris lindleyi (DC.) A. Gray, Proc. Amer. Acad. Arts Sci. 9:210. 1874.

RANGE. — Washington to Texas and NW Baja California to Isla Cedros; islands of southern California and NW Baja California.

Palmer found this plant only in the "middle" of the island, on stony ridges, eaten close by goats (Watson 1876:116), and Chambers (1955:285) cited his collection. Greene (1885:225) called it abundant and very rank about the springs and the cypress groves, "where the goats do not now range." It is now widespread in the northern part of the island and as far south as El Picacho, generally scarce but sometimes locally common on grassy slopes.

Convolvulaceae

NOTE. — For *Cressa truxillensis* var. *vallicola*, see Excluded Species, p. 169.

Calystegia macrostegia (Greene) Brummitt ssp. ***macrostegia***

Convolvulus macrostegius Greene, Bull. Calif. Acad. Sci. 2:208. 1885.
Volvulus macrostegius (Greene) Farw., Amer. Midl. Naturalist 12:130. 1930.
Convolvulus occidentalis A. Gray var. *macrostegius* (Greene) Munz, Man. S. Calif. Bot. p. 387. 1935.
Calystegia macrostegia (Greene) Brummitt, Ann. Missouri Bot. Gard. 52:214. 1965.
Convolvulus occidentalis of Guadalupe Island references.

RANGE. — San Miguel, Santa Rosa, Santa Cruz, Anacapa, Santa Catalina, Todos Santos, San Martín, and Guadalupe Islands; intergrading elsewhere with other subspecies.

Palmer found this plant in the crevices of high rocks, hanging down six feet or more, continuing to bloom from March through the summer, a thousand flowers seen on a single plant (Watson 1876:118). Greene (1885:208, 216) found it in crevices of basaltic cliffs and also spreading its long trailing branches abroad among the rocks of declivities at lower elevations, where he counted it among the most conspicuous plants. Franceschi (1893c:137) said it was highly relished by goats but was still keeping its hold on the most perpendicular cliffs, where its drooping green masses formed a striking contrast to the silvery foliage of *Perityle incana*. Moran (1951:159) found it on the inner slope of Outer Islet. It is still conspicuous on cliffs, such as the Lower Circus, in the northern part of the island, and on the southeast coast, often trailing to 25 feet. Seedlings often appear on slopes below the cliffs and elsewhere and in years of few goats may persist, as in the arroyo at Northeast Anchorage in 1965. Southward, in some years, it forms occasional large masses in the bed of Arroyo Melpomene (Fig. 56).

Cuscuta corymbosa Ruiz & Pav., Fl. Peruv. 1:69. 1798.

RANGE. — Southern Baja California and central Mexico to Peru.

Stems pale yellow. Inflorescence axillary, of 1–5 flowers, with some bracts; pedicels 2–4 mm long. Calyx 3–4.5 mm wide, 2–2.5 mm long, gamosepalous, the lobes broadly rounded, entire, ± 2 mm wide. Corolla white, ovoid, ± 5–6 mm long, the segments ovate, rounded at apex in fresh material examined, ± 1.25 mm long and so ± one-fourth tube. Scales narrow, dentate, extending above middle of corolla tube. Filaments short, the free part ± 0.5 mm long; anthers ± 0.4 mm long. Styles 2–3 mm long, the stigmas capitate. Capsules depressed globose, umbilicate at top, dehiscing irregularly at base, capped at apex by withered corolla. Seeds ± 3–4, ± 1.5 mm wide.

FIGURE 56. *Calystegia macrostegia* ssp. *macrostegia* (*M12071*) in the bed of Arroyo Melpomene at 300 m, 5 March 1965, a year of fewer goats.

Known on Guadalupe Island only from one collection: locally common on *Sphaeralcea*, *Mirabilis*, *Perityle*, etc., at 50 m on the lava mesa just north of the fish camp at West Anchorage, 17 April 1970 (*M17420*). In 1957 I collected twice at West Anchorage, though farther south and not at this spot, without finding the dodder; and I have not been there since 1970 to look. Various plants are local on the island, often for obscure reasons; but it seems remarkable that this parasite has been found nowhere else. It grew near a crude landing strip used probably for flying out lobsters or abalone and possibly for flying in foreign plants — though there is no knowing whether planes ever came there, directly or indirectly, from much farther south where the dodder grows. If it should be found spreading to other parts of the island, or no longer found at all, that might suggest it was introduced; but I tentatively treat it as native. Among photographs Meling Lopez left with his specimens at SD was one of cuscuta, with no locality. Although the species is not identifiable from the photo, presumably this is of *C. corymbosa* on the island, showing it was still there in the early 1980s.

In the treatment of Yuncker (1932; and note figs. 94F and G) this plant seems more or less intermediate between vars. *grandiflora* Engelm. and *stylosa* Engelm., both cited from southern Baja California. Styles are included as shown for var. *grandiflora*. Wiggins (1964:1132) called the southern Baja Californian plant var. *grandiflora*, but in his flora (1980:378) he called it just *C. corymbosa*.

Crassulaceae

Crassula connata (Ruiz & Pav.) A. Berger in Engler, Nat. Pflanzenfam. ed. 2, 18a:389. 1930.

Tillaea erecta Hook. & Arn., Bot. Beechey Voy. p. 24. 1830.
Tillaea minima Gay, Fl. Chil. 2:529. 1847.
Tillaea leptopetala Benth., Pl. Hartw. p. 310. 1849.

RANGE. — Oregon to Argentina and Chile; islands of southern California and NW Baja California to the San Benitos.

Palmer found two varieties, in large patches in a few exposed clear spots in the "middle" and at the north end (Watson 1876:115). It is widespread on the island, from the north slope to Outer Islet, and in some places is abundant in good years.

Bywater and Wickens (1984, map 2) showed var. *connata* and also var. *erectoides* M. Bywater & Wickens on Guadalupe Island; and they also annotated some Guadalupe specimens as var. *eremica* (Jeps.) M. Bywater & Wickens. The four varieties they recognized for western North America have largely overlapping ranges and characters; and some differences among the specimens probably result from different temperature and moisture conditions from place to place and from year to year. After considering the matter in some detail (Moran 1992), I decided it was not practical to distinguish their varieties.

Dudleya guadalupensis Moran, Madroño 11:154. 1951.

RANGE. — Endemic to Guadalupe Island; known only on offlying rocks and islets.

Caudex 1.5–3.5 cm thick, to 15 cm or more long, branching to form rounded clumps to 5 dm wide, of 80 or more rosettes. Rosettes subglobose, 3–15 cm wide, of 25–40 (–75) leaves, the leaves pale green to farinose, oblong-oblanceolate, apiculate-acuminate, 2.5–6.5 cm long, 8–13 mm wide, 2–3 mm thick, the base 4–8 mm wide, the margins rounded. Floral stems glaucous, sinuous, curving down first, then up, 2–3 dm long, 4–7 mm thick, bare in lower 5 cm, with 15–35 leaves above, the leaves glaucous, ascending, triangular-ovate, acute, the lowermost 1–2 cm long, 7–10 mm wide. Cyme glaucous, of 2–3 ascending simple or bifurcate branches, the cincinni 4–8 (–12) cm long, with 7–12 (–17) flowers; pedicels erect, the lower 3–5 (–8) mm long, the upper 2–3 mm long. Flowers April-June. Calyx 5–6 mm wide, 6–8 mm high, rounded below, the tube 1–1.5 mm long, the segments narrowly triangular-ovate, acute, slightly unequal, 3–5 mm long, 2.5–3.5 mm wide. Corolla pale greenish yellow but glaucous and appearing almost white, 11–13 mm long, ± 4 mm wide at base and 7–11 mm wide above, the petals linear-lanceolate, acute, 2–2.5 mm wide, connate 1–2 mm, strongly keeled, nearly straight, erect or ascending and not touching much above calyx. Stamens erect, the filaments ± 9 mm long, adnate ± 1–2.5 mm, the epipetalous higher; anthers yellow, ± 1 mm long. Nectar glands whitish, 1 mm or more wide. Pistils nearly erect but separated, or bowed outward with styles connivent, the ovaries ± 4–6 mm long, the styles at first ± 2 mm long, becoming 3–4 mm long. Mature follicles ascending, the ventral margins ± 60–75° above horizontal. Chromosomes: $n = 17$.

This plant was first found on Outer Islet in 1948, the type *Moran 2947* (DS324267, 324268). It is fairly common from the inner slope of the crater to the upper valley (Fig. 57). Here the leaves are uniformly light green. In 1957 I found it occasional on Islote Negro, with a green form (*M5620*) and a farinose form (*M5619*) (Fig. 58). Here rosettes are often solitary or few, though they may form clusters to 4 dm wide. In August 1970, looking from a boat, I saw what clearly was this plant on Middle Rock. In 1955 George Lindsay wrote me he was sure he saw *Dudleya* plants on rocks off the north end of the island, and this species seems to me probable.

Dr. Charles H. Uhl made chromosome counts of the type collection, from Outer Islet,

FIGURES 57 and 58. The endemic *Dudleya guadalupensis*, found only on offlying islets FIGURE 57. Plant on Outer Islet (*M5644*), with old dried floral stems and with young floral stems growing down and then up; 11 February 1957. FIGURE 58. Cincinnus of plant from Islote Negro, grown in San Diego, 6 June 1957.

and of three collections (*M6044*, *M6706*, *M6798*) from Islote Negro, in all four finding $n = 17$. Thus the plant is diploid relative to the basic number for the genus (Uhl and Moran 1953).

Funamoto et al. (1985) reported a somatic count of $2n = 102$ from a plant supposedly of this species and supposedly from Guadalupe Island. However, I have had no response from the authors about the origin of their plant or whether a voucher specimen is deposited in any herbarium where their identification can be checked. Although they seem to imply that their plants were collected in the wild, it is most unlikely that any of the authors got to this remote island or, if so, was able to find this plant, known only from two inaccessible islets off the windward side and south end.

A plant in the nursery trade in Southern California as *D. guadalupensis* proves to be *D. greenei* Rose. In 1990 David Grigsby of Vista kindly gave me plants of it (*M31032*, SD) that he had as Abbey Garden 69-1168, supposedly field collected. Since neither Charles Glass nor the supposed collector could verify this information, the source of the plant is uncertain but probably is not Guadalupe Island, where *D. greenei* is unknown. For this collection Charles H. Uhl got a chromosome count of $n = 51$, as in other collections of *D. greenei*. Since this count corresponds to the somatic count reported by Funamoto et al., I suspect that their plants came from a nursery and not from Guadalupe Island. From this circumstantial evidence, I reject the report of Funamoto et al., based on dubious material and at variance with Dr. Uhl's four counts of $n = 17$ based on authentic material.

When the type was collected in April 1948, the rosettes had about 35–70 leaves and were very compact, the outer leaves tightly folded over the inner (Moran 1951, plate 3). Immature leaves less than 2 cm long were many, making up about half the total; and they were nearly equal in size rather than grading evenly from youngest to mature, as is usual in *Dudleya*. In cultivation the rosettes became more open, with 25–40 leaves grading more evenly from small to large, and thus appeared more typical for the genus. In later years, plants on the islets also had this more typical appearance. Thus the plants of the type collection were somewhat abnormal, presumably because of some unusual growing conditions. Young floral stems of the type collection became etiolated before they were unpacked; and although they went on to flower in Santa Barbara, the pedicels were elongate and the flowers somewhat abnormal (Moran 1951: plate 3, below). From flowering plants later collected on the islets and from plants flowering in San Diego (Figs. 57, 58; plate 1E), the description above is improved over the original description.

Dudleya virens (Rose) Moran ssp. **extima** Moran, Haseltonia 3:9. 1995.

Dudleya hassei, *D. virens*, and probably *Cotyledon* of Guadalupe Island references.

RANGE. — Endemic to Guadalupe Island.

The first report of *Dudleya* from Guadalupe Island was by Franceschi (1893c:135), who found only one small plant of *Cotyledon* ___ on a rock along the trail not far from the landing. Apparently he brought back the living plant, but if it ever flowered, no specimen or other record seems to remain. Very likely his plant was of this species, which is rare on cliffs in the canyon back of the landing of Franceschi's day.

In 1948 I found a sterile plant of this species (*M2913*) at 800 m on what I have since called Hemizonia Cliff at the north end of the island (Moran and Lindsay 1950, with photo). It grows mostly on cliffs in the north and northeast parts of the island: one plant (*M17308*) on a rock under oaks on the northwest slope at 700 m; north rim of Barracks

Canyon, 450 m (*M6123*); cliff in Barracks Canyon near confluence of south and west forks, 420 m (*M7830*); in shade on north-facing cliffs, Esparsa Canyon at 250 m (*M5972* type, SD; *M6131*). Though scarce, it seems to be holding its own despite goats and botanists, mostly high above their reach.

Dudleya virens is insular (Moran 1995), otherwise growing on San Nicolas, Santa Catalina, and San Clemente Islands, and on seacliffs at the south foot of San Pedro Hill, a former island related to Catalina and San Clemente Islands but now connected to the mainland by the alluvial Los Angeles Plain (see Smith 1900). It is smaller from north to south, the Guadalupe plant conspicuously different from the robust plant on Point Vicente on the mainland. There and on Catalina Island (ssp. *insulare*), clumps are up to 2 m wide, the caudex 2–6 cm thick, the rosette leaves 1–3 cm wide, the floral stems 2–7 dm tall and 5–15 mm thick, and the many-branched inflorescence 10–25 cm wide. Plants of San Clemente Island (ssp. *virens*) are intermediate in size. On Guadalupe Island clumps are ca. 1–2 dm wide, the caudex 1–2.5 cm thick, the rosette leaves 6–15 mm wide, the floral stems 1–2 dm tall and 2–5 mm thick, the inflorescence 2–12 cm wide.

The two collections from Hemizonia Cliff (*M2915*, *M6436*; Fig. 59) have oblong-oblanceolate farinose leaves, in what happened to be clustered subsessile rosettes. The collections from cliffs in the canyons farther south have narrower and more sharply acute green leaves, and in age the stems are pendent to 3 dm. When *M2915* flowered in cultivation and turned out to be tetraploid, I placed it with the somewhat larger tetraploid *D. hassei* (now *D. virens* ssp. *hassei*) of Catalina Island and so reported that species from Guadalupe Island (Moran 1960). When one of the green narrow-leaved plants (*M5972*) proved to be diploid, I thought it might be feasible to distinguish two taxa on the island, different cytologically as well as morphologically. But then when the second collection from Hemizonia Cliff (*M6436*) also proved to be diploid, it seemed better, if not entirely satisfactory, to keep all the plants of Guadalupe Island in one subspecies of *D. virens*.

Crossosomataceae

Crossosoma californicum Nutt., Jour. Acad. Nat. Sci. Philadelphia, Ser. 2, 1:150. 1847.

RANGE. — Endemic to Santa Catalina, San Clemente, and Guadalupe Islands, and San Pedro Hill, a landlocked island north of Santa Catalina.

Palmer found only nine shrubs, in the crevices of cliffs overhanging the canyons in the "middle" of the island, out of reach of the goats and accessible only by the aid of a rope (Watson 1876:112). Franceschi (1893c:133) saw only one, on the almost inaccessible cliff of the Lower Circus. Moran (1951:159) found one small shrub on the inner slope of Outer Islet but saw none on later visits. A few others have survived until recently on cliffs in the northeast part of the island and possibly are reproducing there to a limited extent, in Esparsa Canyon, in Barracks Canyon, and on the cliffs of Oak Canyon and the Lower Circus. However, the plants very likely are decreasing in numbers and so seem threatened with extinction.

Cruciferae

†****Brassica nigra*** (L.) Koch in Roehl, Deutsch Fl. ed. 3, 4:713. 1833.

RANGE. — Native to Europe; a widespread weed in North America.

Palmer found this weed in considerable quantity in the "middle" of the island, in open

spots and on the best soil; he said it was eaten by the goats (Watson 1876:113). No one has found it since, and very likely the goats ate it all. Dr. Reed Rollins wrote me in 1988 that he did not find the Palmer specimen at GH, but Wallace (1985:54) cited one at NY.

†*__Brassica rapa__ L., Sp. Pl. p. 666. 1753.

Brassica campestris L., Sp. Pl. p. 666. 1753.

RANGE. — Native to Europe; a common weed in western North America.

Greene (1885:221) found a few plants near the cabins but added that the species apparently was not yet well established. No one has found it since, and apparently it never did become established.

*__Capsella bursa-pastoris__ (L.) Medik., Pflanzeng. 1:85. 1792.

RANGE. — Native to Europe; a cosmopolitan weed.

Brandegee collected this weed on the island in 1897, but Howell (1942:149) was first to report it. He found it occasional on a rocky slope below the upper corral on the trail to the cypress grove. It grows in the northern part of the island, mostly at higher elevations, as on the northwest slope and about the spring, in good years locally common and lush, less commonly in the mouths of the canyons.

__Descurainia pinnata__ (Walter) Britton ssp. __menziesii__ (DC.) Detling, Amer. Midl. Naturalist 22:508. 1939.

Sisymbrium canescens of Guadalupe Island references.

RANGE. — Central California to NW Baja California; Santa Rosa, Santa Cruz, Anacapa, Santa Catalina, San Clemente, Los Coronados, and Todos Santos Islands.

Palmer found this plant in great abundance in warm sheltered localities (Watson 1876:113). Howell (1942:149) found it occasional in a meadow in the cypress grove. I found a small colony on the south inner slope of the crater of Outer Islet. It seems to be generally scarce on the island, if not now extinct.

Detling (1939:509) cited Brandegee's Guadalupe Island collection as ssp. *menziesii* but cited Howell's as ssp. *halictorum* (Cockerell) Detling. Raven (1963:322) noted that the plants from San Clemente Island and some from Guadalupe Island have been considered ssp. *halictorum* but that their affinities with ssp. *menziesii* were more obvious.

__Erysimum moranii__ Rollins, Contr. Gray Herb. 200:193. 1970.

Erysimum insulare of Guadalupe Island references.

RANGE. — Endemic to Guadalupe Island; known only on Outer Islet.

This is a shrub to 5 dm high with stems to 1 cm thick, with densely appressed short silvery pubescence, yellow flowers in March to June and even August, and straight spreading siliques 2–5 cm long.

Moran (1951:154) found this plant occasional on the inner slope of the crater of Outer Islet. It also grows in the upper valley of Outer Islet but has not been found on the main island or elsewhere.

On the basis of flowering specimens with young fruit, Rossbach (1958:122) referred to the plant of Outer Islet as an atypical form of *E. insulare* Greene, otherwise of San Miguel, Santa Rosa, and Anacapa Islands. In naming *E. moranii*, Rollins said that in its shrubby habit it was most like *E. insulare* and *E. suffrutescens* (Abrams) G. Rossb. among American species. He thought it might be more closely related to *E. suffrutescens*, of the California coast, and particularly to var. *grandifolium* G. Rossb., of Santa Barbara and San Luis Obispo Counties.

Guillenia lasiophylla (Hook. & Arn.) Greene, Leafl. Bot. Obs. 1:227. 1906.

Sisymbrium reflexum Nutt., Proc. Acad. Nat. Sci. Philadelphia 4:25. 1850.
Thelypodium lasiophyllum (Hook. & Arn.) Greene, Bull. Torrey Bot. Club 13:142. 1886.
Caulanthus lasiophyllus (Hook. & Arn.) Payson, Ann. Missouri Bot. Gard. 9:303. 1922.

RANGE. — Washington to northern Baja California; islands of southern California except San Nicolas; also Todos Santos, Cedros, and Natividad.

Palmer found this plant abundant in the "middle" and at the "south end" of the island, in low grounds (Watson 1876:113). Payson (1923:306) cited Palmer's collection and one by Brandegee. Howell (1942:149) found it occasional in the middle and southern parts of the island. It is now rather scarce in the northern part of the island and widespread in the southern part, where it may be locally common in good years.

Hutchinsia procumbens (L.) Desv., Jour. Bot. 3:168. 1814.

Capsella procumbens (L.) Fr., Novit. Fl. Suec. Mant. 1:14. 1832.

RANGE. — British Columbia to central Baja California and the Old World; San Miguel, Santa Rosa, Santa Cruz, Anacapa, San Nicolas, and Santa Barbara Islands.

Howell (1942:149) found this plant in gravelly soil at the south end of the island. I have found it scarce and in only two places: north outer slope of Outer Islet (*M5655*) and on talus of north-facing seacliff northeast of Campo Sur at 50 m (*M13766*).

Lepidium lasiocarpum Nutt. var. ***latifolium*** C. L. Hitchc., Madroño 8:136. 1945.

L. lasiocarpum of Guadalupe Island references.

RANGE. — Baja California to Arizona and Sonora; Isla Clarión.

Palmer found this plant in ravines in the "middle" of the island and rarely at the "south end" (Watson 1876:113). It is widespread on the island, from the pine ridge and Northeast Anchorage to the mouth of Arroyo Melpomene and in good years locally common. From Guadalupe Island Hitchcock (1945:136–137) cited collections by Palmer, Howell, Brandegee, and Mason.

ϕ***Lepidium nitidum*** Nutt. ex Torr. & A. Gray, Fl. N. Amer. 1:116. 1838.

RANGE. — Washington to NW Baja California; islands of southern California except San Miguel; also Los Coronados and Todos Santos.

Howell (1942:150) was first to report this plant from the island; he saw it only on the trail to the cypress grove. It now also grows near the spring and in the shallow valley below the Lower Circus. It seems remarkable that the earlier collectors did not find it, and I list it with the west American plants that are possibly late arrivals (Table 2).

Lepidium oblongum Small var. ***insulare*** C. L. Hitchc., Madroño 8:125. 1945.

L. bipinnatifidum, *L. menziesii*, and *L. oblongum* of Guadalupe Island references.

RANGE. — San Miguel, Santa Cruz, Anacapa, San Nicolas, Santa Catalina, San Clemente, Todos Santos, Guadalupe, Cedros, San Benito, and Natividad Islands.

Palmer found this plant generally abundant on warm hillsides throughout the island (Watson 1876:113). It is widespread, from the pine ridge to the south end and in good seasons fairly common.

The type of this variety is *Palmer 7* (NY; isotypes GH, MO) from Guadalupe Island. From Guadalupe Hitchcock also cited collections by Palmer in 1889, Rose, Drent, Greene, and Brown. He said that most material from the mainland of California and Baja California has larger silicles than do the insular plants and is otherwise somewhat intermediate with the widespread typical variety.

****Raphanus sativus*** L., Sp. Pl. p. 69. 1753.

RANGE. — Native to Europe; a common weed in western North America.

Meling López (1985:50) was first to find this weed on the island, in the corrals in the cypress wood. It was still there in 1988 (*M31006*), uncommon with abundant *Sisymbrium orientale*.

****Sisymbrium irio*** L., Sp. Pl. p. 659. 1753.

RANGE. — Native to Europe; a weed in western North America.

Howell (1942:149) was first to find this weed on the island, seeing it in 1932, only near the barracks. Apparently the only other collection until recently was from the lobster camp (*Weber & McCoy 11*) in 1963. In 1988 it was occasional at Northeast Anchorage (*M31001*) and with the more common *S. orientale* in open ground near the cabin at the northeast edge of the cypress grove (*M31007*), perhaps from a new introduction.

****Sisymbrium orientale*** L., Cent. Pl. 2:24. 1756.

RANGE. — Native to the Old World; a common weed in western North America.

This weed is a recent arrival, not reported before. In 1988 it was occasional at Northeast Anchorage (*M31000*) and near the spring (*M31004*) and locally common in open ground near the cabin at the northeast edge of the cypress (*M31005*).

Thysanocarpus erectus S. Watson, Proc. Amer. Acad. Arts Sci. 11:124. 1876.

RANGE. Guadalupe and Cedros Islands; north central Baja California.

Palmer found this plant only between Jacks Bay (West Anchorage) and Mount Augusta, in clear level spots (Watson 1876:113). Howell (1942) found it not common, on rocky slopes between the cypress grove and the broad transverse valley. It appears to be local in the central part of the island: occasional on bare rocky areas of red soil at 800–900 m, south of the cypress grove (*M6675*); scarce in Juniper Canyon at 100 m (*M12059½*); scarce in Long Canyon at 200 m (*M12076*).

Cucurbitaceae

Marah guadalupensis (S. Watson) Greene, Leafl. Bot. Obs. 2:36. 1910.

Megarrhiza guadalupensis S. Watson, Proc. Amer. Acad. Arts Sci. 11:138. 1876.
Echinocystis guadalupensis (S. Watson) Cogn., Monogr. Phan. 3:819. 1881.
Micrampelis guadalupensis (S. Watson) Greene, Pittonia 2:129. 1890.

RANGE. — Endemic to Guadalupe Island?

Tuber (the one dug) irregular because among rocks, 47 cm high, 12 × 6 cm wide above, tapering downward. Stems to 6 m long and 7 mm thick; internodes to 20 cm long. Leaf blades orbicular to ovate in outline, 10–27 cm wide, mostly 5-lobed ± to middle, the lobes triangular-ovate to oblong, acute to obtuse, the sinus 3–6 cm deep, wider to narrower than deep, the margins sinuate to denticulate or somewhat dentate, the upper surface slightly papillate-scabrous, minutely pubescent, especially on veins, the lower surface more nearly glabrous; petiole 4–13 cm long; tendrils bifid or trifid, the peduncle 3–8 cm long. Staminate flowers 6–20 in raceme, or in panicle 1–3 dm long of up to 6 racemes, on pedicels 3–20 mm long; calyx lobes linear-subulate, 1.5–3 mm long; corolla white, broadly campanulate, 12–30 mm wide, the tube obconic, 3–5 mm long, the lobes unequal, triangular-oblong, rounded to subacute, 6–14 mm long, 3–7 mm wide; anther head subglobose, 1.5–2.5 [?] mm wide. Pistillate flowers on pedicels to 2 cm long; calyx lobes linear, 2 (–7?) mm long; corolla white, open-campanulate, 18–40 mm wide, the tube 2–4 mm long, the lobes oblong-lanceolate, acute to obtuse, 8–14 mm long, 2–5 mm wide. Fruit ovoid, short beaked, to 6 cm long and 5 cm thick, striated from base to apex, short pubescent, rather sparsely spinose, the spines 1–15 mm long, to 1–2 mm wide at base, glabrous or puberulent; peduncle 5–8 cm long. Seeds 2–4, ovoid lenticular, 28 mm long, 25 mm wide, 14 mm thick (immature), olivaceous, the circumferential line inconspicuous. Flowers December to May. (Description broadened from Stocking 1955.)

Palmer found this plant in crevices of high rocks in the "middle" of the island (Watson 1876:138). Franceschi (1893c:135) saw it only among rocks on the right bank of the canyon not far from the landing, but he was assured that it grew all over the island. He noted that young shoots appeared about the middle of January. It is now uncommon, in the north on cliffs but in the south sometimes growing well within reach of the goats yet showing no damage (Fig. 60): Barracks Canyon, 475 m; Esparsa Canyon, occasional on cliffs and banks, 50 m (*M5974*), on talus to 250 m; narrow talus above beach, south of Esparsa Canyon (*Wiggins & Ernst 56*); Juniper Canyon, 50 m (*M6455*); Long Canyon, 200 m (*M12078*); canyon behind lobster camp, 50 m; Arroyo Melpomene, 400 m (*M6734*).

Stocking (1955) kept *M. guadalupensis* as an endemic of Guadalupe Island, characterized by large campanulate corollas, linear calyx teeth, in pistillate flowers "6–7 mm long", and weak-spined two-seeded fruit. Besides the type collection (*Palmer 33*, GH, US), he cited collections by Anthony, Brandegee, and Franceschi. The island plants of southern California he called *M. macrocarpus* (Greene) Greene var. *major* (Dunn) Stocking (= *M. major* Dunn), differing from typical mainland *M. macrocarpus* in their larger leaves, flowers, and seeds. Wallace (1985:15) also kept *M. guadalupensis* as a Guadalupe endemic, placing other island plants in *M. macrocarpus*. Schlising (1993) and Junak et al. (1995) treated some Channel Island plants as *M. macrocarpus* var. *major*, thus by implication also recognizing *M. guadalupensis*. On the other hand, Ferris (1960:70) broadened *M. guadalupensis* to include much of *M. major* but kept some other island plants in *M. macrocarpus*; and Wiggins (1980:393) did the same. Raven (1963:340) treated the San Clemente Island

FIGURE 59. Plant of the endemic *Dudleya virens* ssp. *extima* (*M6436*) from a cliff high at the north end, flowering in San Diego, 11 May 1960

FIGURE 60. The endemic *Marah guadalupensis* (*M6455*) at the mouth of Juniper Canyon, 50 m, 16 December 1957. It is accessible to goats but is bitter and not eaten

plants under *M. macrocarpus* but remarked that much more fruiting material was needed from the islands before definite conclusions could be reached. He thought that although the extremes were very different, it did not seem useful at that time to recognize the variety on the islands, and he thought the plants from Guadalupe Island also very probably conspecific with *M. macrocarpus*. More fruiting material still is needed.

Stocking (1955) thought the wide-ranging *M. oreganus* (Torr. & A. Gray) Howell, with its comparatively large calyx lobes and sparsely-spined fruit, was primitive in the genus; and he thought *M. guadalupensis* much like it in flowers and fruit and perhaps its closest relative. Although I have found no mature fruit and seeds of *M. guadalupensis*, immature fruits on five collections from different places on the island are fairly uniform in size, with spines not so sparse as in *M. oreganus*, often as short as 2 mm but sometimes to 15 mm. In two plants growing side by side (*M12078, 12078A*), spines were short in one, long in the other. Greene (1885:223) wrote that the fruit was conspicuously flattened laterally, but this was not true in those I saw; possibly he meant the seeds.

In its large leaves and large flowers the Guadalupe plant differs from mainland *M. macrocarpus* and agrees with the later-named *M. major*. Calyx lobes are longer than decribed for other species, though I did not find them so long in the pistillate flowers as both Watson and Stocking described them. There is still a question whether this is distinct from *M. major* and so whether *M. guadalupensis* is confined to Guadalupe Island. Tim Ross, who has on loan the three cited cotypes of *M. major*, writes me that *Trask 91* is from San Nicolas Island and *Trask 280* and *281* from San Clemente Island. It is to be hoped that future collectors will get mature fruit and seeds.

Ericaceae

†***Arctostaphylos*** sp.

RANGE. — Unknown; perhaps endemic to Guadalupe Island.

Greene (1885:225) found a single seedling of not more than two or three years' growth, under a cypress; he called the species apparently new. There are no further reports, and the plant is undoubtedly extinct. Greene's specimen has not been found.

Euphorbiaceae

NOTE. — For *Chamaesyce melanadenia* and *Stillingia linearifolia* see Excluded Species, p. 168.

Chamaesyce pondii (Millsp.) Millsp., Field Mus. Nat. Hist. Bot. Ser. 2:411. 1916.

Euphorbia pondii Millsp. in Vasey & Rose, Contr. U. S. Natl. Herb. 1:12. 1890.
Euphorbia guadalupensis J. T. Howell, Leafl. W. Bot. 1:51. 1933.

RANGE. — West central Baja California and Guadalupe Island.

On his second trip Palmer collected this plant (*883*, F, GH) at the south end of the island. Although Vasey and Rose (1890:21–27) failed to list it with his Guadalupe Island collections, Millspaugh mentioned Palmer's Guadalupe specimen in describing the species on p. 12 of this same paper. Howell (1933, 1942:151) found the plant occasional on gravelly flats or in coarse sandy soil on dry windswept slopes at the south end. It appears to be local near the west edge of south end mesa, at 100–200 m, just above Campo Sur.

Howell (1933) described *Euphorbia guadalupensis* as a Guadalupe Island endemic, based on his collections *8331* (type CAS) and *8195*, from Melpomene Cove. However, Wheeler (1934) pointed out that it was the same as *E. pondii*. Besides the Guadalupe specimens, Wheeler (1936:12) cited for *E. pondii* only the type collection, from Playa Maria. He said *E. pondii* was close to *E. polycarpa* Benth. var. *polycarpa* but was a small annual.

Euphorbia misera Benth., Bot. Voy. Sulph. p. 51. 1854.

RANGE. — Southern California to Sonora and central Baja California; Santa Cruz, Santa Catalina, San Clemente, Los Coronados, Todos Santos, San Martin, San Benito, and Cedros Islands.

Drent in 1898 was first to collect this plant on Guadalupe Island, though his find went unreported. Moran (1951:157) found it common on the floor and occasional on the inner slope of the crater of Outer Islet. It is rather rare on cliffs in the northeast part of the island and scarcely more common on the mesa at the south end: two in Esparsa Canyon, 300 m (*M6130*), one at 230 m (*M18152*); lobster camp, 70 m (*M6449*); Arroyo Melpomene, 350 m (*M12072*), 170 m (*M13767*); south end mesa, 100 m (*M13767*).

Catalina, San Clemente, Los Coronados, Todos Santos, San Martin, San Benito, and Cedros Islands.

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Fagaceae

Quercus tomentella Engelm., Trans. Acad. Sci. St. Louis 3:393. 1877.

Quercus chrysolepis of Guadalupe Island references.

RANGE. — Endemic to Santa Rosa, Santa Cruz, Anacapa, Santa Catalina, San Clemente, and Guadalupe Islands.

Palmer reported the oak as frequent at the north end and occasional in canyons on both sides of the island (Watson 1876:119). Greene (1889:45; 1890a:57) saw a few trees at the "cool foggy summit" of the north end and a few more, somewhat different in appearance, "in entirely different soil, and on the very opposite kind of exposure, namely in certain dry, heated canyons of the southeastward slope." "It seems to exist on Guadalupe only in a few more than middle-sized trees, at the cool, foggy summit of the north end of the island; and in a scarcely more considerable number of smaller, and smaller-leaved trees (possibly not of the same species) in the hot and dry canyons of the eastward slope." Franceschi (1893c:138) mentioned oaks in the northwestern part of the island with the palms, as well as a few scattered trees at the north end; he reported oaks in two places more than a mile apart on the east side under the cliffs of the Lower Circus; and he said that the oak was the only tree to be seen in the southern part of the island. And Howell (1942:147) told of a few trees near the head of Barracks Canyon (Figs. 61, 62).

Watson listed Palmer's two numbers (*88, 89*) as "*Q. chrysolepis* Liebm.; fide Dr. Engelmann," and Engelmann (1877) referred both to *Q. tomentella* when he founded the species.

FIGURES 61 and 62. The island oak, *Quercus tomentella*, endemic to Guadalupe and five of the Channel Islands. FIGURE 61. Two trees at the mouth of Oak Canyon, a tributary of Barracks Canyon (*M6443*), 14 December 1957; these trees are now gone. FIGURE 62. Tree on north slope of the island, 28 March 1978.

Greene, Franceschi, and Howell, however, all pointed out differences between the oaks at the north end and those of the east side.

Franceschi described the trees of the northwest slope as "fine specimens forty to sixty feet high, remarkable for the grayish color of the bark and the size of the leaves, which are glossy dark green on the upper surface and covered with a somewhat rusty tomentum beneath." Howell described specimens from the grove illustrated by Eastwood (1929, plate 34, figs. 1, 2): "The twigs and the lower side of the leaves of the current season are densely tomentellous with rather loose buff-colored hairs. The older branches are glabrate or nearly so and the lower side of older leaves are only thinly pubescent and slightly glaucous."

Franceschi wrote that the oaks of the east side, "if not specifically distinct appear at least to be a very different form, not only by the leaves but also by the bark, which is darker and corky. These trees are rather stunted and branching from the base." Of specimens from these trees, Howell wrote: "Although these specimens are not entirely typical of *Q. chrysolepis* Liebm., they are more like that species than [like? or are?] the specimens from the north end. The leaves are more coriaceous; the upper side is light green and the lower side is entirely pale and chalky with a scattering of those peculiar glandular trichomes characteristic of the canyon live oak of California. The pubescence on the twigs and petiole is thick and close, quite unlike the relatively shaggy pubescence of [the oak from the north end]. I was able to obtain acorns and cups, and these resemble the acorns and cups of that form of *Q. chrysolepis* that occurs in the mountains of southern California that has been called *Q. crassipocula* Torr."

Greene considered the trees at the north end as typical *Q. tomentella*. He thought the trees of Santa Cruz Island corresponded more closely to those on the east side of Guadalupe Island than to those at the north end.

Dr. C. H. Muller collected the oak at the north end in 1957 and studied my collections (*M6439–M6443*) from Oak Canyon on the east side. He wrote me that the trees at the north end agree more closely with those on the islands of California and are biologically more typical of the species, whereas those of Oak Canyon show strong introgression by *Q. chrysolepis* but agree more closely with the type specimen.

The main stand of oaks apparently was with the pines at about 600 to 700 m on the steep northwest slope of the main northeast ridge (Fig. 62). Other oaks are scattered along the northwest slope of this ridge up to perhaps 900 m, and a few more are scattered among the palms of the northwest slope west of the main stand. The total number of trees at my first visit was probably less than 100, and they have been falling with the years.

Of the oaks formerly in the canyons of the east side, two small groups remained at the time of my visits. One must be the more northern of the two groups mentioned by Franceschi and is where Mason (*1537*) and Howell (*8173*) collected. These trees were at ca. 850–900 m in the north fork of Barracks Canyon, in the steep gorge through the cliffs of the Lower Circus or rim of the lower plateau which I call Oak Canyon (Fig. 61). In 1957 there were nine living trees, or perhaps seven, two with trunks double from the base; they were 8–10 m tall, with trunks to 6 dm thick and bark in thin grayish plates. Two of these trees, undercut by the torrent that flows after rains, had fallen; and by 1960 one of these was gone. By 1981 only four trees remained and by 1988 only one. José Rico, just back from the island in July 1994, told me that too was gone.

In 1967 there were five oaks (*M13788, M13789*) at 450 m in a hanging tributary on the

north side of Esparsa Canyon about 3 km east of Mt. Augusta, which I call Southeast Oak Canyon (Fig. 26). The trees were about 8 m tall, with widespreading branches, in some places decumbent on the rocks. José Rico told me in 1994 that only two remained.

In 1988 a single spreading tree stood at 1100 m at the head of Esparsa Canyon on the east slope just south of Mt. Augusta (*M31008*).

In 1970 there were two oaks at 700 m on the steep west slope below the gray peak above West Anchorage (*M17394*). They were erect, about 8 m tall, with trunks to 5 dm thick.

Minnich (1987:124) wrote that *Q. tomentella* occurs south of the U.S. border only in central Baja California "in an arroyo 3 km east of Mt. Augusta and on Guadalupe Island." So far as known, however, neither the oak nor the mountain occurs on the peninsula.

Frankeniaceae

Frankenia salina (Molina) I. M. Johnst., Contr. Gray Herb. 70:92. 1924.

Frankenia grandifolia Cham. & Schltdl., Linnaea 1:35. 1826.

RANGE. — Central California to Nevada, central Baja California, and South America; islands of southern California except Santa Barbara, and also Todos Santos.

Dudley (1899:281) reported this plant on the side of the bank near Northeast Anchorage, where no one else has found it before or since. The only other locality known on the island is at 5 m on the low barren lava flat, near the upper limit of salt spray, at the southwest corner of the island, northwest of Campo Sur (*M6472*, *M13756*).

Geraniaceae

****Erodium brachycarpum*** (Godr.) Thell., Rep. Bot. Exch. Club Brit. Isles 5:17. 1918.

RANGE. — Native to North Africa; naturalized in western North America.

This weed was getting well started in 1978: occasional in shallow grassy valley below Lower Circus, 800 m (*M25374*); occasional east of the principal spring, 1000 m (*M25376*). By 1988 it was abundant about the spring (*M31011*) and elsewhere on the upland.

****Erodium cicutarium*** (L.) L'Hér. ex Aiton, Hort. Kew. 2:414. 1789.

RANGE. — Native to southern Europe; widely naturalized in western North America.

Palmer found this weed abundant all over the island, and the principal food for the goats, covering the rocks; usually three or four inches high by August (Watson 1876:113). Greene (1885:222) saw very little of either species, but Franceschi (1893c:134) said it literally covered the whole surface of the island. It now extends the length of the island and is one of the very commonest plants on rocky slopes in the northern half.

****Erodium moschatum*** (Burm.f.) L'Hér. ex Aiton, Hort. Kew. 2:414. 1789.

RANGE. — Native to southern Europe; widely naturalized in western North America.

Palmer found this weed in the "middle" of the island, less common than the last and starting later in the spring (Watson 1876:114). Franceschi (1893c:134) found it plentiful all over, chiefly among rocks and stones, but not so common as *E. cicutarium*. Howell

(1942:150) found it throughout the island, especially at lower elevations, and said the two species are perhaps the commonest plants after *Hordeum*; and that is still true.

Grossulariaceae

†***Ribes sanguineum*** Pursh, Fl. Amer. Sept. p. 164. 1814.

RANGE. — British Columbia to NW California; Guadalupe Island.

Palmer found only two plants of this species, in the damp shade of cliffs at the north end (Watson 1876:114); and no one else has seen it. Quite possibly it is extinct on the island, and I have marked the name with a dagger. Nevertheless, I am reluctant to declare the case closed, for the foggy northwest cliff has many inaccessible damp shady ledges, on some of which it might possibly survive.

Eastwood (1929:407) thought this must be some other species because this one is found in California only at the extreme north. However, Peter Raven wrote me in 1962 that Otto Solbrig had checked Palmer's specimen and found it to be *R. sanguineum* — with glabrous styles and glandular fruit.

Hydrophyllaceae

Emmenanthe penduliflora Benth., Trans. Linn. Soc. 17:281. 1835.

RANGE. — Central California to Utah, Arizona, and central Baja California; Santa Cruz, Santa Catalina, and San Clemente Islands.

Palmer found this plant in rocky ravines in the "middle" of the island (Watson1876:118) and on his second trip saw it in canyons and on hillsides at both ends of the island (Vasey and Rose 1890:26). Greene (1885:226) called it abundant, very large and handsome, far surpassing what one sees of this species in California. It is occasional or locally common in arroyos and on rocky slopes in the northeast part of the island and south as far as the lobster camp.

Eucrypta chrysanthemifolia (Benth.) Greene var. ***chrysanthemifolia***

Eucrypta chrysanthemifolia Greene, Bull. Calif. Acad. Sci. 1:200. 1885.

RANGE. — California to NW Baja California; San Miguel, Santa Rosa, Santa Cruz, Anacapa, Santa Barbara, Santa Catalina, and San Clemente Islands.

Palmer collected this plant apparently with the following (Watson 1876:118). It is occasional in the northeast part of the island, favoring more shaded places than the following. Constance (1938:146) cited the collections of Palmer and Mason.

Constance recognized both the species and the variety, with generally different but somewhat overlapping ranges.

Eucrypta chrysanthemifolia (Benth.) Greene var. ***bipinnatifida*** (Torr.) Constance, Lloydia 1:147. 1938.

Ellisia chrysanthemifolia of Guadalupe Island references.

RANGE. — SE California to Nevada, Arizona, and central Baja California.

Palmer found this plant abundant under sage brush on warm hillsides from the "middle" to the north end and also rarely at the "south end" (Watson 1876:118). It is occasional or locally common in canyon bottoms and among rocks in the northeast part of the island.

From Guadalupe Island Constance (1938:148) cited *Palmer 74* and *Anthony 252*. Many collections he found impossible to assign with any degree of certainty to either the species or the variety, and he remarked that the rather abundant collections from Guadalupe Island illustrate admirably the confusing transitions that occur whenever the two occur together.

Phacelia floribunda Greene, Bull. Calif. Acad. Sci. 1:200. 1885.

Phacelia phyllomanica A. Gray var. *interrupta* A. Gray, Proc. Amer. Acad. Arts Sci. 11:87. 1876.

RANGE. — Endemic to Santa Barbara, San Clemente, and Guadalupe Islands.

Rather dense annual to 6 dm high and wide; flowers lavender, February to May.

Palmer found this plant frequent in warm nooks in rocky ravines in the "middle" and at the "south end" of the island (Watson 1876:118). Greene (1885:226) found it in the lower parts of the island. It is occasional in arroyos in the southern half of the island, from the lobster camp and West Anchorage south and on Islote Negro and Outer Islet, and less common now in the northern part.

Gray named the variety from Palmer's Guadalupe Island collection (No. 72, GH holotype). Greene thought it in no wise resembled the gigantic half shrubby *P. phyllomanica*, of the upper precipices, except as regards the pinnately parted calyx lobes. In *M5653*, from Outer Islet, Marion Cave found $n = 11$ (Cave and Constance 1959).

Phacelia phyllomanica A. Gray, Proc. Amer. Acad. Arts Sci. 11:87. 1876.

RANGE. — Endemic to Guadalupe Island.

Leafy subshrub 1–2 m high and to 2 m wide, canescent with dense short soft hairs and above longer villous, not hispid or glandular but somewhat viscid above. Leaves 6–10 cm long, 3–4.5 cm wide, pinnatisect, with 13–25 crowded oblong-linear pinnatifid segments, the lobes short, oblong, sometimes few-toothed. Cincinni thyrsoid-congested, to 5 cm long, with 40–55 flowers, at first dense, the flowers sessile. Calyx segments either all leaflike and 3–5-pinnately parted or 1–3 broadly linear and entire. Corolla blue-violet, slightly exceeding calyx, the scales short and broad. Annular disk conspicuous, the stamens subexserted. Chromosomes: $n = 11$. (Fig. 63)

Palmer found this plant rare, in large compact masses in the crevices of high rocks in the "middle" of the island (Watson 1876:118). Gray named the species from Palmer's collection (No. 72, GH type). Greene (1885:226) said it was shrubby below and often more than six feet high, the largest species known. Franceschi (1893c:136) saw a considerable number in a limited locality on the cliff east of the corral; he called it a most elegant shrub, with finely cut foliage, dark green above and whitish below. In January 1960 and May 1967 I found a group of about eight shrubs, not flowering, high overhead on the cliffs of the Lower Circus (*M7836*, *M13782*). One was ± 1.5 m high and 2 m wide. In 1981 I saw 6 or 8 large clumps out of reach on ledges of the western cliffs at 1075 m, northwest of the cypress grove. Seeds from 1960 grew at the U. C. Botanical Garden, flowering September 1962 (Fig. 63), and Marion Cave got a count of $n = 11$ (apparently unpublished).

FIGURE 63. The endemic shrubby *Phacelia phyllomanica* (*M7836*), grown in Berkeley from seed from the Lower Circus, 3 September 1962

Pholistoma racemosum (Nutt.) Constance, Bull. Torrey Bot. Club 66:349. 1939.

Nemophila racemosa Nutt. ex A. Gray, Proc. Amer. Acad. Arts Sci. 10:315. 1875.
Nemophila aurita of Guadalupe Island references

RANGE. — Southern California to central Baja California and Isla Cedros; Santa Cruz, Santa Barbara, Santa Catalina, San Clemente, Los Coronados, Todos Santos, San Martin, Cedros, and Natividad Islands.

Palmer found this plant on warm slopes in the "middle" of the island and rarely at the "south end" (Watson 1876:118). Franceschi (1893c:136) found it plentiful among rocks all over the island. It is widespread in the northern half of the island, from the north slope to Juniper Canyon, locally common among rocks, and less common southward but extending to Outer Islet. From Guadalupe Island Constance (1939:350) cited collections of Anthony, Franceschi, Greene, Palmer, and Rose.

Labiatae

†***Pogogyne tenuiflora*** A. Gray, Proc. Amer. Acad. Arts Sci. 11:100. 1876.

Hedeomoides tenuiflora (A. Gray) Briq. in Engl. & Prantl, Nat. Pflanzenfam. IV, 3a:295. 1896

RANGE. — Endemic to Guadalupe Island.

Palmer found this plant very rare among sage brush on the eastern side (Watson 1876:117). No one has found it since, and undoubtedly it is extinct.

Gray based *P. tenuiflora* on Palmer's collection (No. 65, GH holotype) from Guadalupe Island. This species falls in subgenus *Hedeomoides* A. Gray, which was made a separate genus by Briquet (1896), with the upper pair of stamens sterile. Howell (1931) thought it probably closest to the widespread *P. serpylloides*, mainly of central California and now very rare if not extinct in northwest Baja California near San Quintín.

†***Satureja palmeri*** (A. Gray) Briq. in Engl. & Prantl, Nat. Pflanzenfam. IV, 3a:303. 1896.

Calamintha palmeri, A. Gray, Proc. Amer. Acad. Arts Sci. 11:100. 1876.
Clinopodium palmeri (A. Gray) Kuntze, Rev. Gen. 2:515. 1891.

RANGE. — Endemic to Guadalupe Island.

Palmer found this plant abundant among trees and sage brush in the "middle" of the island (Watson 1876:117). He said it was strong-scented and not eaten by the goats, but he didn't know how hungry they would be. Greene (1885:117) listed it without comment. No one has found it since, and undoubtedly it is extinct.

Gray based the species on Palmer's collection (No. 66, GH holotype?). He placed this species in section *Acinos* and added the following remarks: "Calyx shorter than in *C. acinos*, in fruit less declined or ascending. Except for the four fertile stamens this plant would be referred to *Hedeoma*. The stamens are too straight and distant for a *Calamintha*, but apparently it may be referred to that polymorphous genus."

Leguminosae

Lotus argophyllus (A. Gray) Greene ssp. ***ornithopus*** (Greene) Raven, Aliso 5:326. 1963.

Hosackia ornithopus Greene, Bull. Calif. Acad. Sci. 1:185. 1885.
Syrmatium ornithopum (Greene) Greene, Bull. Calif. Acad. 2:148. 1886.
Lotus argophyllus var. *ornithopus* (Greene) Ottley, Univ. Calif. Publ. Bot. 10:238. 1923.
Hosackia argophylla of Guadalupe Island references.

RANGE. — Endemic to San Nicolas, Santa Barbara, Santa Catalina, San Clemente, and Guadalupe Islands.

Palmer found this plant in the crevice of a rock (Watson 1876:114). Greene (1885:185, 216) called it frequent in the middle of the island and mentioned it as one of four conspicuous plants of middle altitudes where the trail climbed out of the canyon above the landing. Moran (1951:157) found it on the inner slope of the crater on Outer Islet. In the northern part of the island it is occasional on cliffs, with seedlings often seen on the slopes below. It is fairly common at West Anchorage and southward, often in arroyos. The type of *Hosackia ornithopus* is Greene's collection of April 19, 1885, from Guadalupe Island (UC 80750, part of type). From var. *ornithopus* Isely (1981) separated the plants of San Nicolas, Santa Barbara, San Clemente, and Santa Catalina Islands as var. *argenteus* Dunkle, thus leaving ssp. *ornithopus* only on Guadalupe Island. He wrote that Guadalupe plants had clusters of greatly exserted pods, some with 3 seeds, whereas plants from the northern islands have shorter pods, with only 2 seeds, as in other forms of *L. argophyllus*.

Lotus grandiflorus (Benth.) Greene, Pittonia 2:145. 1890.

Hosackia grandiflora Benth., Trans. Linn. Soc. 17:366. 1837.

Lotus guadalupensis Greene, Pittonia 2:144. 1890.
Lotus grandiflorus (Benth.) Greene var. *mutabilis* Ottley, Univ. Calif. Publ. Bot. 10:208. 1923.

RANGE. — Northern California to NW Baja California; Santa Rosa, Santa Cruz, and Santa Catalina Islands.

Palmer found this plant among trees in the "middle" of the island (Watson 1876:114). Greene (1885:222) saw no trace of it at Palmer's locality and found only a single large bushy plant in a nearly inaccessible crevice on the face of a cliff. No one saw it again until April 1963, when Weber and McCoy (*11969*) and Copp (*146*) found it rather common, flowering in the arroyo bed at Northeast Anchorage. It was still there in February 1965 (*M12012*), but I failed to find it in 1967 and later. It seems unlikely to have been growing at Northeast Anchorage, the usual landing, all those years without having been found. Presumably it survived on some cliff above, got started in the arroyo in a year when goats were few, then disappeared when goats increased again. *Meling L. 014*, of March 1982, is labeled "Extremo Sur," the extreme south end, which seems very improbable. Meling L. (1985:54) reported finding four plants near the "aguaje del bosque" and one in an arroyo near the south end.

Greene (1885) at first reported his collection as *Hosackia grandiflora*. He later (1890b) described *Lotus guadalupensis* as follows: "Branches stout, erect, 2 feet high, from a suffrutescent base, and with the other parts minutely velvety: internodes short, not equalling the sessile leaves: leaflets about 5 pairs, obovate-oblong, mucronulate: peduncles stout, surpassing the leaves, the 6–10-flowered umbel with a large 1-foliate bract: calyx-teeth subulate-setaceous, rather shorter than the oblong-campanulate tube: corolla 6 to 7 lines long, yellow. . . . It is singular among the species of this group in having numerous leaflets equally distributed on the rachis; so that only on account of its gland-like stipules is it retained in this place. But it is very closely related to [*L. leucophaeus* Greene] though more remote from the true *L. grandiflorus*."

Ottley (1923:208) and Wiggins (1980:680) included *L. guadalupensis* in *L. grandiflorus*.

ϕ***Lupinus bicolor*** Lindl., Bot. Reg. 13: pl. 1109. 1827.

Lupinus bicolor Lindl. var. *microphyllus* (S. Watson) C. P. Sm., Bull. Torrey Bot. Club 50:382. 1924.
Lupinus bicolor Lindl. ssp. *microphyllus* (S. Watson) D. B. Dunn, Aliso 3:151. 1955.

RANGE. — British Columbia to Sonora and central Baja California; islands of southern California except Santa Barbara.

The first collections of this plant from Guadalupe Island are by Drent in 1898 and Brown in 1906, both without specific localities (Smith 1923:385). It grows in grassy places in the northeast part of the island, from Northeast Anchorage and the spring to El Picacho, generally rather scarce but in a few places locally common in good years. Since earlier botanists failed to find it even though they collected in the general area where it now grows, I list it as a possible late arrival (Table 2).

This plant has been reported before as *L. bicolor* var. or ssp. *microphyllus*, but Riggins and Sholars (1993:628) found the named varieties and subspecies ± indistinct in geography and morphology and in need of further study.

Lupinus guadalupensis Greene, Bull. Calif. Acad. Sci. 1:184. 1885. (Not *L. guadalupensis* C. P. Sm. 1951.)

RANGE. — Endemic to San Clemente and Guadalupe Islands.

Greene (1885:184) found this plant on the high plateau of the island, in good fruit but nearly past flowering April 23. It now appears to be rather scarce and local on the east side of the island just below the middle, at 100–650 m, from the mouth of Long Canyon to the slopes of El Picacho and the slope south of Mt. Augusta. Besides Greene's collections, Dunn (1957) cited one by Brandegee.

On San Clemente Island this plant has been named *L. clementinus* C. P. Sm., *L. aliclementinus* C. P. Sm., and *L. moranii* Dunkle. Dunn (1955) considered it an insular relict connecting *L. nanus* and *L. affinis* with certain Mexican species.

Lupinus niveus S. Watson, Proc. Amer. Acad. Arts Sci. 11:126. 1876.

RANGE. — Endemic to Guadalupe Island.

This is a densely white tomentose bush to 4 dm high and 1 m wide, mostly living only one season, with light blue flowers. (Fig. 64)

Palmer found this plant only in the "middle" of the island, on high cliffs, only one plant in bloom, March 25 (Watson1876:114). Greene (1885:222) also saw only one flowering plant and that almost inaccessible; but numerous seedlings of this, or else of an annual species with the same pubescence, were growing on level ground south and west of the cabins, where the goats no longer ranged. On his second trip Palmer found it in flower and fruit March 29 in the sandy bed of a canyon at the south end (Vasey and Rose 1890:23). In the northern part of the island it is rarely found flowering on cliffs, but the seedlings are occasional, widespread on the slopes and down to the beach. At the south end in a good year it is abundant and beautiful in sandy arroyo beds (Plate 1F).

Smith (1922:205) called this a very distinct isolated insular species, not closely related to any other known species but better lined up with *L. nanus*, at least for the time. Dunn (1960) grew *L. niveus* in the greenhouse and tried crosses with two subspecies of *L. nanus*. Although he got no seed, some pods started to develop, suggesting to him that the two species had some affinity and that the placement of *L. niveus* in the *Micranthi* was correct. Harmon and Dunn (1968) found in the greenhouse that *L. niveus* was a short-lived perennial. (At the south end of the island I noted a few plants that clearly were living over a second year.) They also crossed it with several shrubby Californian perennials and a South American annual. They concluded that *L. niveus* is a relictual species transitional between these shrubby lupines and the annual *Micranthi*.

****Medicago polymorpha*** L., Sp. Pl. p. 779. 1753.

Medicago hispida Gaertner, De Fruct. Sem. Pl. 2:349. 1791.

RANGE. — Native to southern Europe; a widespread weed in western North America.

Howell (1942:150) was first to report this weed on the island; he saw it only near the barracks. I also have seen it only in that vicinity. The var. *brevispina* (Benth.) Heyn. is also there.

FIGURE 64. The endemic *Lupinus niveus* grown in San Diego, 29 May 1981

****Melilotus indica*** (L.) All., Fl. Ped. 1:308. 1785.

RANGE. — Native to Eurasia; a widespread weed in North America

Palmer on his second trip found this plant common along the beach at the north end and ascending into shady canyons (Vasey and Rose 1890:24). I have seen it only at Northeast Anchorage and in the mouth of Esparsa Canyon, in neither place common.

Trifolium depauperatum Desv. var. ***truncatum*** (Greene) Martin ex Isley, Brittonia 32:56. 1980

Trifolium minutiflorum Greene, Pittonia 3:215. 1897
Trifolium amplectens of Guadalupe Island references

RANGE. — Central California to NW Baja California; islands of southern California except Santa Barbara.

Palmer found this plant rare, only on the beach on the east side of the island (Watson 1876:114). Franceschi (1893c:135) saw it only in the canyon near the landing, but not in large numbers. Howell (1942:150) found it common at higher elevations. It is fairly common on the north end and about the spring.

Greene in 1897 described *T. minutiflorum* as follows: "Annual, very slender, glabrous, the numerous branches decumbent, a few inches to almost a foot long: leaflets 1/2 to 3/4 inch long, the lowest exactly linear, truncate or emarginate, the others oblong-linear and abruptly acutish, all somewhat serrately and very evenly denticulate: peduncles filiform, much longer than the leaves: heads not much more than 2 or 3 lines broad in flower; involucre parted into 6 or 7 oblong entire lobes: calyx teeth subulate-lanceolate, herbaceous almost throughout: corollas moderately inflated in age."

"An interesting species, allied to *T. truncatum* and *T. hydrophilum*, which latter it agrees with in having the leaflets of its earliest leaves narrower than those of the later ones, in which respect these two differ from all other West American clovers. This one is of southern California and Guadalupe Island."

ϕ***Trifolium gracilentum*** Torr. & A. Gray, Fl. N. Amer. 1:316. 1838.

RANGE. — British Columbia to NW Baja California; islands of southern California and Todos Santos.

Howell (1942:150) was first to find this plant (*8247*), calling it the common clover at lower elevations at the north end of the island, as on the slope of the pine ridge. It is common on North Point and the uplands about the spring, extending to the beach and to the south end mesa. Because it is so widespread and common now but was not found until 1932, I list it with those west American plants that probably are introduced on the island (Table 2).

Trifolium microcephalum Pursh, Fl. Amer. Sept. 2:478. 1814.

RANGE. — British Columbia and Montana to NW Baja California; San Miguel, Santa Rosa, Santa Cruz, San Nicolas, Santa Catalina, and San Clemente Islands.

Palmer found this clover very abundant at the "middle" and north end of the island (Watson 1876:114). It is widespread, from the beach to Mt. Augusta and from North Point to the northwest slope to El Picacho, often rather common, and then less common southward, as in the bed of Arroyo Melpomene.

Trifolium palmeri S. Watson, Proc. Amer. Acad. Arts Sci. 11:132. 1876.

Trifolium gracilentum Torr. & A. Gray var. *palmeri* (S. Watson) McDermott, N. Amer. Trifol. p. 300. 1910.

RANGE. — Endemic to San Nicolas, Santa Barbara, Santa Catalina, San Clemente, and Guadalupe Islands.

Palmer found this clover rather abundant in the "middle" of the island among rocks and trees on hillsides (Watson 1876:114). On his second trip, in a year of good rainfall, he called it very common in large masses in canyons and plains at the north end and quite common on the south end in wet sand in canyons; he added that it was widely distributed over the island and formed the main food supply of the goats (Vasey and Rose 1890). In the northeast part of the island it grows mainly in the mouths of the canyons, but from

West Anchorage and El Picacho southward it is more widespread and common. It is also on Islote Negro.

Zohary and Heller (1984) followed McDermott in treating this as a variety of *T. gracilentum*; and it is closely related, differing chiefly in leaf shape. However, Raven (1963:328) considered that on San Clemente Island the two were completely distinct both ecologically and morphologically. And they likewise appear distinct on Guadalupe, in South Esparsa Canyon in 1958 growing side by side (*M6598*, *M6599*). Steve Junak tells me he has found them distinct also on Santa Barbara and San Nicolas Islands.

Vicia hassei S. Watson, Proc. Amer. Acad. Arts Sci. 25:129. 1890.

Vicia exigua var. *hassei* (S. Watson) Jeps., Fl. W. Mid. Calif. p. 296. 1901.

RANGE. — Southern Oregon to NW Baja California; Santa Rosa, Santa Cruz, Anacapa, San Nicolas, Santa Catalina, San Clemente, Los Coronados, and Todos Santos Islands.

Palmer in a wet year called this plant common on shady sides of ravines at the north end (No. 847, Vasey and Rose 1890:24). Ordinarily, it is rather scarce on the island, as on the slope above Northeast Anchorage and on El Picacho. Commonly this has been called a variety of *V. exigua*, now included in *V. ludoviciana*. However, Lassetter (1975) and Gunn (1979) have treated it as a monomorphic species of more limited range, similar to the polymorphic *V. ludoviciana* but distinguished by the apical abaxial stylar brush and the pubescent ovaries and pods. Gunn cited Guadalupe collections by Palmer (*847*), Wiggins and Ernst (*200*), and Moran (*M6643*).

Vicia ludoviciana Nutt. ssp. ***ludoviciana***

Vicia ludoviciana Nutt. in Torr. & A. Gray, Fl. N. Amer. 1:271. 1838.
Vicia exigua Nutt. in Torr. & A. Gray, Fl. N. Amer. 1:272. 1838.

RANGE. — To SE US and N Mexico: the *exigua* phase Northern California to NW Baja California; Santa Rosa, Santa Cruz, Anacapa, Santa Catalina, and San Clemente Islands.

This species seems to be slightly more common than the other, as near the spring, in Esparsa Canyon, in the arroyo bed of Long Canyon, and at West Anchorage.

According to Gunn (1979), *V. ludoviciana* includes two subspecies, and ssp. *ludoviciana* consists of five geographic races (phases) that are not given formal names: phase *exigua*, corresponding to *V. exigua* Nutt., grows mainly in southern California and northwest Baja California. Lassetter (1984) reached similar conclusions and in his fig. 5 showed his race 4 confined to California and Baja California, including Guadalupe Island.

Loasaceae

Mentzelia micrantha (Hook. & Arn.) Torr. & A. Gray, Fl. N. Amer. 1:535. 1840.

Mentzelia dispersa of Guadalupe Island references.

RANGE. — California to NW Baja California; Santa Cruz, Santa Catalina, and San Clemente Islands.

Palmer found this plant in ravines in the "middle" and at the "south end" (Watson 1876:115); and on his second trip he reported it common in canyons at the south end

(Vasey and Rose 1890:24). Greene (1885:223), failing to find *M. dispersa* of Watson's list, reported *M. micrantha* as an addition to the flora, seen only on the beach near the landing and probably a recent introduction. It is widespread mostly at low elevations, mostly in arroyo beds, from Northeast Anchorage to Arroyo Melpomene, but nowhere common.

Although Watson and Vasey and Rose identified Palmer's specimens as *M. dispersa* S. Watson, Darlington (1934:193) cited at least one of his specimens as *M. micrantha* and cited no Mexican collections of *M. dispersa*. Harry Thompson in 1975 verified my six collections as *M. micrantha*.

Malvaceae

Lavatera lindsayi Moran, Madroño 11:158. 1951.

RANGE. — Endemic to Guadalupe Island, and known there only on Outer Islet and Middle Rock.

Open shrub to 7 dm tall and 11 dm wide, the stem to 4 cm thick; herbage velvety with a dense stellate puberulence. Leaf blades round-cordate with sinus nearly closed, 3–9 cm wide, 5- to 7-lobed one-third of way to base or less, the lobes rounded, coarsely crenate; petioles 2–5 cm long. Flowers several in upper axils, pendent on jointed pedicels nearly equalling flowers, campanulate, 4.5–5.5 cm wide. Involucel 8–15 mm long, of 3 oblong rounded bracts united in lower third. Calyx 20–25 mm long in flower, to 32 mm long in fruit, divided nearly to middle into triangular-ovate acute or acuminate segments. Petals erect or slightly ascending but not widespreading, deep purple throughout, with darker veins, obovate-spatulate, emarginate, 3–5 cm long, 10–18 mm wide. Staminal column 25–35 mm long. Fruit 9–12 mm wide, enclosed in calyx; mericarps 8–10, smooth, 1-seeded. This shrub flowers January to August (Figs. 65, 66; Carlquist 1965, fig. 14-7).

This shrub grows on the north outer slope, on the inner slope, and in the upper valley of Outer Islet, from 20 to 190 m, and I also saw it in 1970 on Middle Rock; it has never been found on the main island. Flowers were collected in January, February, and April, with *L. occidentalis*, and most plants were still flowering in June and August, when *L. occidentalis* was past flowering and largely leafless. In the upper valley where the two occur together, I found a single plant that seemed to be a hybrid (*M5650*); the petals are erect below, spreading from near the middle, whitish with 5 diffuse purple stripes and suffused with purple between.

Lavatera lindsayi differs from *L. occidentalis* in its denser puberulence, smaller and more shallowly lobed leaves, later flowering, and more erect purple petals (Plate 2G). Since the two grow together and since their flowering times overlap, the apparent rarity of hybrids is noteworthy. Moreover, plants of *L. occidentalis* on Outer Islet are even less puberulent than other collections of that species and agree with them in floral characters, thus in these respects showing no approach to *L. lindsayi*. Yet it is remarkable that of all collections of *L. occidentalis*, those from Outer Islet (Fig. 68) most closely approach *L. lindsayi* (Fig. 66) in leaf shape, having comparatively short and rounded lobes.

Lavatera occidentalis S. Watson, Proc. Amer. Acad. Arts Sci. 11:124. 1876.

Lavatera insularis S. Watson, Proc. Amer. Acad. Arts Sci. 12:249. 1877.

RANGE. — Endemic to Guadalupe and South Coronado Islands.

FIGURES 65 and 66. The endemic *Lavatera lindsayi* on Outer Islet. FIGURE 65. Flowering shrub (*M15118*), 21 June 1968. FIGURE 66. Flowering branch (*M5648*), 11 February 1957

Summer-deciduous shrub 0.5–3 m tall and to 2 m or more wide, or hanging from cliffs to 4 m, the trunk to 1 dm thick, the herbage thinly stellate-puberulent. Leaves round-cordate, 6–16 cm wide, 7-lobed a third to nearly half way to base, the lobes rounded to subacute, to 3.5 cm long and 3 cm wide, coarsely crenate, the sinus nearly closed to open at 110–130°, the petioles 3–23 cm long. Flowers axillary, solitary, on deflexed pedicels 2–3 cm long and jointed just above middle. Involucre of 3 subequal bractlets 7–10 mm long, 2–5 mm wide, connate 1.5–3 mm. Calyx in flower 25–28 mm long, the lobes foliaceous, 18–19 mm long, 12–13 mm wide; in fruit 30–36 mm long or 5.5–6.6 cm wide, the lobes spreading, ovate, acute, veiny, (15–) 18–25 mm long, (10–) 15–19 mm wide. Petals ascending in lower third (within calyx), then spreading or somewhat recurved, narrowly spatulate with a broad naked claw, emarginate, 4–6 cm long, 13–15 mm wide above, ± 4 mm wide at base, greenish white below, whitish diaphanous above, with 3 faint narrow diverging purple stripes near center above. Staminal column ± 25–27 mm long, the broad base dark purple. Style ± 9 mm long, the lobes ± 22 mm long. Fruit 12–15 mm wide, enclosed in calyx, finely pubescent; carpels 6–10, 4.5–5.5 mm high, about equalling the short conical summit of the axis. Seeds dark brown, 4.5 mm wide. The shrub flowers January to April and was seen flowerless and nearly leafless in June and August.

Palmer found this shrub conspicuous on the cliffs in the "middle" of the island, only rarely and with difficulty accessible, in flower and immature fruit in April (Watson 1876:113). Greene (1885:222) called it a larger shrub than described, the large ones 10 feet high. Franceschi (1893c:134) saw a few scattered specimens, all on the most inaccessible rocks east of the island, and found a few seedlings not likely to survive. Moran (1951:157) found it common on the inner slope of the crater on Outer Islet. There are also a small colony on the floor of the crater, at 30 m, and a few plants in the upper valley. Here the plant is likely to survive, but on the main island it is now very rare and only on cliffs. In 1960 two large dense shrubs grew on cliffs of the Lower Circus (*M7835*, *7835a*), quite possibly in the place meant by Palmer and Franceschi, one near the base, the other high out of reach (Fig. 67); but by 1981 the lower one was gone. In 1970 two grew at 300 m on the south rim of Esparsa Canyon at the mouth (*M18145*). In 1963, a year when plants were somehow getting ahead of goats, Weber and McCoy found a single seedling (*11968*) near the zigzag trail above the barracks, but I failed to find it there in 1965. And in 1965 I found a single young plant ± 1 m high on the bank of Arroyo Melpomene at 400 m (*M12074*), which I did not find again in 1967.

The plants of Outer Islet are small, rarely more than 1 m tall. The leaves are more sparsely puberulent than in other collections and are lobed only about a third of the way to the base, with rounded lobes, and the sinus is nearly closed (Fig. 68). The plants of Esparsa Canyon had leaves with very open sinuses, which are similar to the leaves of Brandegee's collection (UC). Moran (1951:158) pointed out the close similarity of *L. insularis* S. Watson, of Islas los Coronados, to *L. occidentalis*, of Guadalupe Island, suggesting that it be included in the same species, as Fryxell (1988) did; but in 1985 George Krebs annotated specimens from Coronado as *L. insularis*. That grows only on the south island, where it seemed to be one continuous population, and the collections are rather uniform. Collections from Guadalupe Island are variable in leaf shape, but some closely match the specimens from the Coronado Islands. Greene (1885) said the flowers of *L. insularis* were exactly those of *L. occidentalis*, and so it appears except that they average a little smaller, ± 3–5 cm long. There is little to separate the two.

FIGURE 67 and 68. The insular endemic *Lavatera occidentalis*, found only on Guadalupe and on South Coronado Island. FIGURE 67. One of two plants high on cliff of Lower Circus (*M7835*), 27 January 1960. FIGURE 68. Flowering branch (*M5643*) on Outer Islet, 11 February 1957.

****Malva parviflora*** L., Demonstr. Pl. p. 18. 1753.

Malva borealis of Guadalupe Island references.

RANGE. — Native of Eurasia; a widespread weed in North America and elsewhere.

Palmer found this plant only on the richer open spots in the "middle" of the island, in dense masses (Watson 1876:113), but after his second trip reported it now introduced all over the island (Vasey and Rose 1890:23). Greene (1885:221) found it very common on the eastward slope. It is now widespread over the island and some places locally common, especially on the north slope.

Sphaeralcea palmeri Rose, Contr. U. S. Natl. Herb. 1:23. 1890.

RANGE. — Endemic to the southern half of Guadalupe Island.

Plant perennial with a stout woody crown to 2 cm thick, densely yellowish canescent with very short hairs, those of the stems 0.15–0.20 mm long, with ca. 25 rays. Stems erect or arching to prostrate, conspicuously angled, mostly 2–6 dm long and 2–4 mm thick and dying back nearly to the thick woody base but in sheltered spots sometimes persisting and to 1 m long and 1 cm thick. Leaf blades thick, rugose, with veins very prominent beneath, broadly ovate to subrhomboidal, 3-veined from base and sometimes faintly 3-lobed, at base cuneate, at apex obtuse to rounded or retuse, rarely acute, 2.5–6 cm long, 2–4.5 cm wide, crenulate-toothed, the petioles stout, 1–4 cm long, 1/5–1/2 as long as blade. Inflorescence a narrow thyrse with lower branches not more than 5 cm long. Pedicels stout, shorter than fruiting calyx. Calyx at anthesis 6–9 mm high, with ovate acutish strongly ribbed lobes equalling in length the angular-ribbed tube. Petals widespreading, white or pinkish, yellowish or yellowish green at base, conspicuously veined, narrowly obovate with long narrow claws, 13–17 mm long, 4–10 mm wide, with dense tuft of hairs on each margin near base. Column sparsely or rather copiously pubescent. Fruit higher than hemisperical, about 2/3 as high as fruiting calyx. Carpels 12–17, with chartaceous walls, 4–5 mm high, ca. half as wide, broadly and shallowly notched, the dehiscent part erect, ovate, at apex rather narrow but obtuse, muticous, the indehiscent part forming 1/4–1/2 of the carpel, rather prominently reticulate; attaching threads short. Seeds 2, very pubescent. (Description modified from Kearney 1935.)

Palmer, on his second trip, found this plant in all exposed parts on the south end of the island (Vasey and Rose 1890:23). Moran (1951:159) reported it occasional on the crater floor, Outer Islet. It is fairly common at West Anchorage and on the south end mesa and also grows on Islote Negro (Fig. 69) as well as Outer Islet.

Rose based the species on *Palmer 867* (type US; GH, K, NY, UC) and *868*. Kearney (1935) kept it distinct from *S. sulphurea*, his concept of the species based only on five specimens of Palmer's two collections. His key characters for *S. palmeri* were plant yellowish-canescent (vs. whitish-canescent or tomentose), stems conspicuously angled (vs. terete or nearly so), leaf blades with veins very prominent beneath, strongly cuneate (vs. with veins not very prominent beneath, subcordate to subcuneate), calyx conspicuously ribbed (vs. not conspicuously ribbed), and carpels about 17 (vs. about 12); and his descriptions suggest various other differences. With the study of more material of both species, these differences seem to hold up to some degree, though some of them become less absolute. In particular, there is considerable overlap in the number of carpels, though there appears to be some difference in the means. Kearney placed these two species by themselves in his section *Sulphureae*, distinguished by the petals less than half as wide

FIGURE 69. The endemic *Sphaeralcea palmeri* (*M5988*) on Islote Negro, 19 April 1957.

as long. His chart of hypothetical relationships shows this section as rather isolated but closest to the *Emoryanae*. That section includes two species of central and southern Baja California and one extending from southern Nevada and southeast California to northern Sonora and northern Baja California. Fryxell (1988) closely followed Kearney's treatment.

Sphaeralcea sulphurea S. Watson, Proc. Amer. Acad. Arts Sci. 11:125. 1876.

Sida hederacea and *S. leprosa hederacea* of Guadalupe Island references.

RANGE. — Endemic to Guadalupe Island.

Plant perennial, to ± 1 m high and 1–1.5 m wide, with rather stout woody crown, densely whitish canescent or tomentose with short hairs, those of stem 0.2–0.4 mm long, with 20–25 rays. Stems numerous, erect or arching from near base, to 5 mm thick. Leaf blades usually thickish, with veins not very prominent beneath, broadly ovate, deltoid, or nearly orbicular, at base subcuneate to subcordate, at apex very obtuse to acutish and sometimes mucronate, 3–5-veined from base, shallowly 3-lobed at or below middle with rounded or acutish lobes, the margin finely to rather coarsely crenate and often somewhat rugose, the larger blades 3–9 cm long, 2/3 as wide to wider than long, the petioles slender or rather stout, 1/3–1 1/2 times as long as blade. Inflorescence an interrupted many-flowered thryse, narrow or with lower branches up to 12 cm long, and often forked. Pedicels rather stout, usually much shorter than fruiting calyx. Calyx at anthesis 5–7 mm high, with lanceolate or deltoid-ovate, acute or short-acuminate lobes 1–2 1/2 times as long as tube. Petals in bud pale orange at tips, in anthesis spreading, white, greenish or yellowish at base, conspicuously veined, oblanceolate or narrowly obovate with long narrow claws, 10–15 mm long and 1/3 to 1/2 as wide. Column sparsely pubescent. Fruit higher than

hemispherical, ± 2/3 as high as calyx; carpels ± 2, with thin, chartaceous walls, 3–4.5 mm high and 1/2 to 2/3 as wide, shallowly to rather deeply notched, the dehiscent part erect or ascending, ovate or deltoid, obtuse, muticous to short-cuspidate, the indehiscent part forming about 1/3 of carpel, prominently and somewhat coarsely reticulate; attaching threads short or rather long. Ovules 2 or 3. Seeds 1–3, sparsely pubescent. (Description modified from Kearney 1935.)

Palmer found this plant very abundant on rocky slopes and in the crevices of the highest rocky ridges, from the "middle" of the island to the "southern end," where it was most frequent (Watson 1876:113). Greene (1885:216) found it quite abundant on the gentler declivity leading to the plateau from the zigzag trail out of the canyon. Franceschi (1893c:134) called it much more abundant than lavatera, one of the very few plants of which some meager specimens may be seen scattered about even in places occasionally visited by goats; he saw seedlings and young plants near the landing, both on the beach and on the dry lava rock. It is common on cliffs in the northeast part of the island, from Northeast Anchorage and Esparsa Canyon to the Lower Circus, and south as far as the lobster camp. In 1981 I saw it on western cliffs at 1075 m, northwest of the cypress grove. It seems not to be at the north end. Kearney (1935:34) cited specimens of Palmer (No. 18 GH, type; CM, F, K, MICH, MO, NY, PH, UC, US), Greene, Franceschi, Brandegee, Drent, Anthony, and Mason.

From a collection of Thoburn, Green, and Wing in July 1897, Dudley (1899:282) listed "Sphaeraclea? Material scanty. Near northeast landing." The specimen (DS 140703) was annotated by T. H. Kearney as "Sida hederacea ?" and by I. D. Clement in 1948 as "? Sida leprosa var. hederacea"; but Clement (1957:58) cited it as *S. leprosa* var. *hederacea* (Dougl.) K. Schum., without the query. Most leaves are folded so that it is hard to tell their shape, but some clearly are ovate and longer than in the sida. There is no question that this is the sphaeralcea.

Nyctaginaceae

Mirabilis californica A. Gray in Torr., Bot. Mex. Bound. p. 173. 1859.

Hesperonia heimerlii Standl., Contr. U. S. Natl. Herb. 13:412. 1911.
Mirabilis heimerlii (Standl.) J. F. Macbr., Contr. Gray Herb. 56:24. 1918.
Mirabilis laevis of Guadalupe Island references.

RANGE. — SW California and NW Baja California; Santa Rosa, Santa Cruz, Anacapa, Santa Barbara, Santa Catalina, and San Clemente Islands and islands of NW Baja California.

Low shrub to 2 m wide and mostly 2–3 dm high, with many prostrate branches, the stem to 2 cm thick, with gray bark, the branches brittle, glabrous, glaucous, much swollen at nodes. Leaf blades subsucculent, deltoid-ovate, cordate at base, obtuse or acutish, 1–4 (–5.5) cm long, to 4.5 cm wide, ± 1 mm thick, usually glabrate but younger ones glandular puberulent, the petioles half as long as blades or upper ones much shorter. Involucres numerous in axils of leaves, on peduncles 0.5–3 mm long, or congested at ends of branches, campanulate, often purplish, densely glandular-puberulent, 3–6 mm long at anthesis, 5–8 mm long in fruit, the lobes deltoid to ovate, 1–3 mm long. Perianth purple, 8–12 mm long, glandular-puberulent on parts exposed in bud. Anthocarp globular to prolate, 3–4.5 mm long, 2.5–3 mm thick, dark brown.

Palmer found this shrub in crevices of the walls of canyons on the east side (Watson

1876:118) and on his second trip reported it common at the south end (Vasey and Rose 1890:26). In the northeast part of the island it is not uncommon on beach cliffs, ascending to 450 m on the north rim of Barracks Canyon at the mouth, and occasional on cliffs in the canyons. In the southern part it is more common, especially near the shore but also inland in arroyos and on mesas, at least to 350 m, as well as on Islote Negro and Outer Islet.

Standley (1911) based *Hesperonia heimerlii* on *Palmer 886* (US22626, holotype), from the south end of Guadalupe Island, and on collections of Franceschi and Rose. He named it for Dr. Anton Heimerl, a student of the family, who had marked specimens of it as a new species. Standley said that the form of the fruit ("spherical or slightly depressed vertically") placed it near *M. cedrosensis* Standley, from which it differed in its pubescence, the plants "glandular pubescent, never scabrate." Likewise, Macbride (1918) separated *Mirabilis heimerlii* by its "truly globose fruit." Wiggins (1980:149) and Wallace (1985:21) also recognized *M. heimerlii* as a Guadalupe endemic. Recent collections, however, show that the fruit varies and is often somewhat longer than thick.

Since Ferris (1964) has clarified the distinction of *M. californica* A. Gray from *M. laevis* (Benth.) Curran, the Guadalupe plant clearly belongs to the *M. californica* complex, agreeing in the form of the involucre. It is perhaps woodier than typical *M. californica* and tends to differ in its shorter anthocarp and perhaps larger leaves. From var. *cedrosensis* it differs in its pubescence, which is fairly uniform in all collections. No combination of characters is evident to separate it from all other members of this complex, and it is similar to some plants of San Clemente Island.

Oleaceae

†***Hesperelaea palmeri*** A. Gray, Proc. Amer. Acad. Arts Sci. 11:83. 1876.

RANGE. — Endemic to Guadalupe Island.

This was a rather compact glabrous tree 20 to 25 feet high, with entire coriaceous mostly opposite leaves and terminal panicles of perfect 4-merous lemon-colored flowers, and with fruit undoubtedly drupaceous (Fig. 70).

Palmer found only three live trees, in a canyon on the east side; he saw no young trees but many dead ones (Watson 1876:118). Brandegee (1900:22) remarked that goats were not the only exterminators of endemic species, "for I searched in vain for Hesperelaea at the exact locality where Dr. Palmer found it and could only find a goat corral made from trees chopped down in the vicinity." No one has seen it since, and it is undoubtedly extinct.

Gray called this genus remarkable in the Oleaceae for its wholly distinct and unguiculate petals, imbricate above, and its apparently uniformly isomerous stamens. The genus has remained monotypic and so is endemic to Guadalupe Island.

Onagraceae

Camissonia guadalupensis (S. Watson) Raven ssp. ***guadalupensis***

Oenothera guadalupensis S. Watson, Proc. Amer. Acad. Arts Sci. 11:137. 1876.
Camissonia guadalupensis (S. Watson) Raven, Brittonia 16:284. 1964.
Oenanthe guadalupensis of Guadalupe Island references.

FIGURE 70. Flowering branch of the remarkable *Hesperelaea palmeri*, a small tree of the Oleaceae, now extinct. In 1875 Palmer found many dead but only three still alive; no one has found it since. *Hesperelaea* was an endemic monotypic genus of Guadalupe Island.

RANGE. — Endemic to Guadalupe Island.

Palmer found only two plants, in a ravine on the east side near the beach (Watson 1876:115). In 1958 Ernst and I found seven plants widely scattered in the bed of Arroyo Melpomene at 450 m (*Moran and Ernst 6737*) (Plate 2H), and in 1965 I found two more in the same arroyo at ca. 300 and 400 m (*M12070*). Raven studied plants raised from the seeds of the first collection, as *Raven 17530* and *18175* (DS).

In a list of plants known only from Guadalupe Island, Vasey and Rose (1890:22) included "9. *Oenanthe guadalupensis* Wat." There is no such name in *Oenanthe*, and no member of that genus has been found on Guadalupe Island or seems likely to be. The similarity

of the generic name, the use of the same specific epithet and author, and the position in the list, together show that this is an error for *Oenothera guadalupensis* S. Watson. Joseph Rose's field notebook for March 1911 (US) shows *Rose 16901* as *Oenanthe guadalupensis*, suggesting that he may have found the rare endemic camissonia in the same part of the island where Palmer found it. However, Dr. Raven wrote me that he was unable to find Rose's specimen at US.

Raven (1963:332) described a ssp. *clementina* from San Clemente Island, where he later (1969:275) reported it as common on dunes around the north end and down the west shore, up to 100 feet elevation. He found it to differ in its spreading rather than appressed strigose pubescence, in the presence of short glandular trichomes in the inflorescence, and in the presence of a red dot near the base of each petal. Raven (1969) found both plants autogamous, with a gametic chromosome number of $n = 7$. Reciprocal F_1 hybrids showed no evidence of chromosomal structural heterozygosity, but reduced stainability of pollen suggested a substantial reduction in fertility in the hybrids, although seed-set did not appear to be impaired.

ϕ***Camissonia robusta*** Raven, Brittonia 16:284. 1964.

Oenothera micrantha of Guadalupe Island references.

RANGE. — Southern California to NW Baja California; San Miguel, Santa Cruz, Santa Catalina, and San Clemente Islands.

Moran (1951:160) found this plant in the canyon mouth at Northeast Anchorage, where it has remained fairly common in later years (Fig. 71). It has also been found near the spring (*Lindsay in 1948*), rather scarce on the northwest slope at 550 m (*M17295*), and near the north rim of Barracks Canyon at 500 m (*M13804*).

Because this plant was fairly common at the landing where every botanical visitor to the island had come ashore without finding it, Moran (1951:160) thought it very likely a new arrival. Raven (1963:298) at first also called it probably introduced. Judging later from the phytogeographic relationships of Guadalupe Island and from the scarcity of the plant on San Clemente Island, however, Raven (1969:305) thought it equally likely that it might simply have gone undetected on Guadalupe before and have become more common recently. He added that it probably will not be possible to resolve this question definitely. I list it with those west American plants that are probably introduced (Table 2).

A missing piece to this puzzle may possibly be the Rose collection (*16901*) of "*Oenanthe guadalupensis*," mentioned under the previous species. Was that really *C. guadalupensis*, or could it possibly have been *C. robusta*? If *C. robusta*, it would show that this plant was already on the island by 1911 and then perhaps more likely native.

†***Epilobium foliosum*** (Torr. & A. Gray) Suksd., Deutsch. Bot. Monatss. 18:87. 1900.

Epilobium minutum Lindl. var. *foliosum* Torr. & A. Gray, Fl. N. Amer. 1:490. 1840.
Epilobium minutum of Guadalupe Island references.

RANGE. — Vancouver Island and Idaho to southern California; Guadalupe Island.

Palmer found this plant only at the north end, among rocks and sage brush (Watson 1876:115). Greene (1885:223) found two or three plants in the same area. No one has seen it since, and it is doubtless extinct on the island.

Seavey, Wright, and Raven (1977) found *E. foliosum* distinct from *E. minutum* Lindl. in

several respects, including chromosome number. Palmer's Guadalupe Island collection (K, MO, NY, UC) was hard to assign to either species, but from the flower size they tentatively called it *E. foliosum*.

Papaveraceae

Dr. Wallace E. Ernst collected poppies on Guadalupe Island in April 1958 and reported some chromosome counts (Ernst 1958). He helped me straighten things out.

†ϕ***Eschscholzia californica*** Cham. var. ***californica***

Eschscholzia californica Cham. in Nees, Hort. Phys. Ber. p. 73. 1820.
Eschscholzia gigas Fedde, Repert. Nov. Sp. 3:28. 1906.

RANGE. — Northern to southern California; San Miguel, Santa Rosa, Santa Cruz, and Guadalupe Islands.

Greene (1885:221) found this plant "luxuriating in one place only, near the edge of a precipice, northeast of the cabins," i.e. near the top of the Lower Circus. Franceschi (1893c:133) reported it plentiful in the same limited locality, its leaves clipped pretty closely by the goats. No one has found it since, and it doubtless is extinct on the island.

Greene described the plant as follows: "Root perennial: stem robust, two feet high: petals orange, two inches long. The true *E. californica*." Franceschi affirmed that it was perennial. Greene (1885:183) wrote that *E. californica* did not appear in southern California except at considerable altitudes in the mountains, as at San Gorgonio Pass and Tehachapi Pass, and he mentioned his collection from Guadalupe Island. He said that in all these localities it was the same robust large-flowered perennial so well known from San Francisco to the borders of British Columbia. Later, however, Greene (1905a) restricted *E. californica* to the San Francisco Peninsula but did not refer the Guadalupe specimen to any other species. Based only on Greene's collection (GH holotype?), Fedde in 1906 named *E. gigas*, thus a Guadalupe endemic, which he thought doubtless related to *E. crocea* and *E. rigida* but different in habit and in the form of the hypanthium. Dr. Ernst wrote me in 1962 that Greene's Guadalupe Island collection of 24 April 1885 at GH was annotated by Fedde as *E. gigas* Fedde. Ernst called this the giant coastal form of *E. californica*, the only specimen of it he had seen from Guadalupe Island.

Greene thought this plant was "possibly of recent introduction." Although conceivably the goat hunters may have beautified the premises by planting California poppies, the ability of *Eschscholzia* to reach this island is shown by the presence of three other species; and the finding of this unexpected northern one is consistent with the occurrence here of such other northern plants as *Polypodium scouleri*, *Ribes sanguineum*, and *Eriophyllum lanatum*. var. *grandiflorum*. On the other hand, since Palmer had camped nearby for 15 weeks without finding this conspicuous plant, or three other plants later found by Greene, very likely it was a late arrival and not well established. I therefore list it with the west American plants probably introduced on the island (Table 2).

Eschscholzia elegans Greene, Bull. Calif. Acad. Sci. 1:182. 1885.

Eschscholzia californica var. *hypecoides* of Guadalupe Island references.

RANGE. — Endemic to Guadalupe Island?

Erect annual 3–6 dm high, branching above base, glabrous, very glaucous. Leaves finely dissected, their ultimate divisions long and parallel or shorter and divergent, linear or

oblanceolate, acute. Calyptra ovoid, apiculate, 10 mm long. Torus cylindrical, the outer rim corky, the inner erect and hyaline. Corolla to 35 mm wide, the petals spreading with margins hardly meeting, 8–20 mm long, greenish yellow when fresh, turning orange on drying. Stamens 16–20, the filaments and anthers about equal. Pods thin-walled, slender, 6–9 cm long. Seeds slightly elongated, apiculate, tuberculate, the raphe obvious. Chromosomes: $n = 17$ fide W. Ernst.

Palmer found this plant only at the "south end" in ravines and in the "middle" of the island on level ground (Watson 1876:112). Greene (1885:183) called it common in the middle and southern parts of the island, the type his collection at CAS? I found it common on the alluvial fan at West Anchorage (*M5604*, *M5956*).

Eschscholzia palmeri Rose, Contr. U. S. Natl. Herb. 1:23. 1890.

Petromecon palmeri (Rose) Greene, Pittonia 5:293. 1905.
Petromecon frutescens Greene, Pittonia 5:294. 1905.
Eschscholzia frutescens (Greene) J. T. Howell, Leafl. W. Bot. 3:149. 1942.

RANGE. — Endemic to Guadalupe Island.

Shrub to 5 dm high and 1 m wide, erect or with decumbent branches, with soft-woody stem to 4 cm thick, the bark corky, golden brown to gray, orange in fissures; but flowering the first season when still tiny and herbaceous. Foliage commonly dense, very glaucous when young, the leaves alternate, pedately dissected into moderately divergent long narrow-linear subterete acute to obtuse segments, the petiole linear, to 4 cm long. Pedicels erect, rising above foliage, persisting stiff and conspicuous, to 17 cm tall. Torus a hemispherical subligneous cup, the outer margin a thick herbaceous ring, the inner elevated, thickish, corky. Calyptra almost spherical to ovate-conic, with short blunt point, 5–15 mm long. Corolla 1.5–6 cm wide, the petals spreading, bright yellow with orange basal spot, cuneate-obovate, 8–26 mm long. Stamens 50–80 or more, the filaments 3–10 mm long, filiform above a flattened base, the anthers linear?, 2.5–3 mm long. Stigmas 4, not greatly elongated, clavellate. Pods 3–7 cm long, hard and subligneus, the valves fluted. Seeds with no superficial papery coat, appendage, or reticulation, but surface uneven by short interrupted subsinuous rugosities. Cotyledons linear, 1.5–3 cm long, ± 1 mm wide. Chromosomes: $n = 11$ fide W. Ernst.

Palmer found this plant at the south end of the island, where he saw it only on a rocky ledge, but there common (Vasey and Rose 1890:23). In the northern part of the island it is occasional on seacliffs and cliffs in the canyons and on the northwest cliff at 600 m (*M17281*). It is more common on the mesa at the south end and on Islote Negro and Outer Islet, where many seedlings may be seen flowering in a good year (Plate 21).

Greene (1905b) proposed the endemic genus *Petromecon* for *E. palmeri* and his new *P. frutescens*. He said the two species had something of the habit of the dendroid insular eschscholzias but a pedatifid foliage and the flowers of *Stylophorum* as to the excessive number of stamens, 80 or more, on long filaments. He added that the torus and the stigmas approached those of *Eschscholzia* but were different, as also were the seeds. Fedde (1909, 1936) continued to recognize *Petromecon* as an endemic genus of Guadalupe. On the other hand, Howell (1942), Ernst (1958), and Wiggins (1980) returned it to *Eschscholzia*. *Eschscholzia palmeri* clearly is a very distinct species but I think no more.

Greene (1905b) based *Petromecon frutescens* on Franceschi's collection of January 1893 from "rocky ledges on the northern slope of Guadalupe," the holotype at CAS. Evidently,

however, this is the plant mentioned by Franceschi (1893c:134) under *E. elegans* var. *ramosa*: "perennial on a nearly inaccessible cliff of lava detritus on the right bank of the canyon 500 or 600 feet from the landing." Howell (1942:149) reported it from ocean bluffs inaccessible to goats near Northeast Anchorage. Greene described the species as much larger than *P. palmeri*, a foot high and as broad; growing branches and their foliage less succulent; older and naked branches wholly and solidly woody, the wood firm, compact, and hard; leaves ample, on long and slender petioles, pedately divided and cleft into long narrow-linear moderately divergent segments; calyx ovate-conic; corolla cruciform, the cuneate-obovate petals not meeting; stigmas 4, rather short, equal; pods and seeds not known.

Ernst (1958) reported $n = 11$ for *E. palmeri* from the south end. Considering plants on cliffs in the canyons to be *E. frutescens*, that may be a shrub to 1 m wide and 5 dm high, with a trunk to 4 cm thick. In May 1967 I compared fresh material of *M13797*, from Esparsa Canyon, and *M13762*, from the talus of the seacliff northeast of Campo Sur, presumably typical *E. palmeri*, with various herbarium specimens. *M13797* was less compact, and the ultimate segments of the leaves more slender, as might be expected from the habitats. The petals were larger, to 26 mm long as compared to 19 mm, and the orange spot was less pronounced. The stigmas were four in both, contrary to the distinction implied by Greene. Plants on Islote Negro, are larger and woodier than Greene supposed, so that difference doesn't hold. Dr. Ernst got a count of $n = 11$ for *M13797*, as he did for plants from the south end. He wrote me in 1958 that he thought *E. frutescens* was just *E. palmeri* growing perhaps a bit shaded and out of the wind on the east side of the island, and I certainly do not see any way to distinguish it.

Eschscholzia ramosa (Greene) Greene, Bull. Torrey Bot. Club 13:217. 1886.

Eschscholzia elegans var. *ramosa* Greene, Bull. Calif. Acad. Sci. 1:182. 1885.

RANGE. —Islands of southern California and northern Baja California, except San Miguel and Anacapa.

Erect compact treelike annual, 2–4 dm high, very glaucous, the stem simple below, compactly branching above. Leaves finely divided, the ultimate lobes short and divergent, often blunt. Torus somewhat urceolate, the rim membranous, and outer rim lacking. Calyptra ovoid, 5 mm long. Corolla smaller than in *E. elegans*, reddening less in drying, 12–25 mm wide, the petals 6–13 mm long. Stamens 16–20?, the filaments 1–2 mm long, the anthers 2–3 mm long. Pods stout and straight, 6–9 cm long, strongly few-striate. Seeds nearly globular, distinctly reticulate. Cotyledons linear, entire, 2.5–4.5 cm long, ca. 1 mm wide. Chromosomes: $n = 12$ fide W. Ernst.

Greene (1885:183) based this species on plants found under high cliffs near the landing at the northeast end of the island. He wrote that the erect compact tree-like habit was peculiar. It is the more common annual species on the beach and near the shore on both sides of the island.

Dr. Ernst wrote me in 1958 that although *E. elegans* and *E. ramosa* are both variable, he thought he could distinguish all the material of them from Guadalupe Island, and he sent me an illustrated key. He said that once he recognized that there were two entities with different chromosome numbers and could release himself from some previous prejudices, he found these differences more easily seen. He said that, in fact, he felt more and more like a true spiritual son of the late E. L. Greene. He added, however, that until he could see fresh material from the other islands, he would be very cautious about extra-

Guadalupe determinations. According to Raven (1963:322), Dr. Ernst then considered *E. elegans* possibly restricted to Guadalupe Island, while plants resembling *E. ramosa* were more widely distributed, having been collected on Santa Cruz, Santa Barbara, Santa Catalina, San Clemente, Guadalupe, Coronado, Todos Santos, San Benitos, and Cedros Islands, though not on the mainland. Wiggins (1964, 1980) included *E. ramosa* in *E. elegans*, with a range from Santa Rosa Island to Guadalupe and Cedros Islands.

†ϕ***Platystemon californicus*** Benth., Trans. Hort. Soc. London, II. 1:405. 1835.

RANGE. — Oregon to Nevada, Arizona, and NW Baja California; islands of southern California except San Clemente.

Brandegee (1900:22) reported this plant from Guadalupe Island but with no specific locality. No one has found it since, and it probably is extinct on the island.

Without explanation, Brandegee called this plant a recent introduction. The fact that it has not been found before or since may suggest that it was a waif that never became established. However, Brandegee made the same statement about *Lasthenia californica*, which seems clearly to be native. Furthermore, although the absence of the poppy from San Clemente, the most oceanic of the Channel Islands, is not reassuring, its presence on the other seven islands does show some ability to reach islands. The question is impossible to resolve, and I list this plant as possibly introduced on the island (Table 2).

Plantaginaceae

Plantago ovata Forssk., Fl. Aegypt.-Arab., p. 31. 1775.

Plantago insularis Eastw., Proc. Calif. Acad. Sci. Ser. 3, 1:112. 1898.
Plantago patagonica of Guadalupe Island references.

RANGE. — Southern California and offshore islands to central Baja California and Cedros Island; also Old World.

Palmer found this plant in level spots at the "south end" (Watson 1876:116). In favorable seasons it is common in the southern half of the island, including Islote Negro, and occasional farther north.

Stebbins and Day (1967) showed that *P. insularis*, described from western North America, was more closely related to the Old World *P. ovata* than to other American plants. On the basis of chromosome differences and apparent small morphological differences, they kept it a separate species, and they argued that it must have reached the New World by natural means, probably at the beginning of the Miocene. Bassett and Baum (1969) treated *P. fastigiata* (including *P. insularis*) as conspecific with *P. ovata* and thought it probably introduced into the New World comparatively recently by man. When it arrived remains uncertain, but I tentatively follow Dempster (1993) in not separating the American plants taxonomically. There is more to learn.

Polemoniaceae

NOTE. — For *Navarretia hamata* see Excluded Species, p. 169.

†***Allophyllum gilioides*** (Benth.) A. D. & V. E. Grant, Aliso 3:105. 1955.

Collomia gilioides var. *glutinosa* and *Gilia divaricata* of Guadalupe Island references.

RANGE. — Oregon to southern California and Arizona; Guadalupe Island.

Palmer found this plant abundant under brush and in protected places in the "middle" of the island (Watson 1876:118). Greene (1885:225) listed it without comment, but Grant and Grant (1955:105) cited Greene's collections. No one has found it since, and very likely it is extinct on the island.

Gilia nevinii A. Gray, Syn. Fl. N. Amer. ed. 2, 2^1:411. 1886.

Gilia multicaulis Benth. ssp. *nevinii* (A. Gray) H. Mason & V. E. Grant, Madroño 9:209. 1948.
Gilia multicaulis and var. *millefoliata* of Guadalupe Island references.

RANGE. — Endemic to Santa Rosa, Santa Cruz, Anacapa, San Nicolas, Santa Barbara, Santa Catalina, San Clemente, and Guadalupe Islands.

Corolla lavender to deep blue-violet, not spotted.

Palmer found this plant very abundant under brush and in protected places in the "middle" of the island (Watson 1876:118). Franceschi (1893c) reported it very common among rocks over the whole island. It is widespread, from the northwest slope and pine ridge to the mouth of Arroyo Melpomene. It grows especially on grassy slopes, where in good years it is often abundant, especially in the higher northern part of the island.

Linanthus pygmaeus (Brand) J. T. Howell ssp. **pygmaeus**

Gilia pygmaea Brand, Pflanzenreich 4^{250}:134. 1907.
Gilia guadalupensis Brand, Pflanzenreich 4^{250}:134. 1907.
Linanthus pygmaeus (Brand) J. T. Howell, Leafl. W. Bot. 2:100. 1938.
Gilia pusilla and var. *californica* of Guadalupe Island references.

RANGE. — Endemic to San Clemente and Guadalupe Islands.

Corolla lobes blue to lavender, throat yellow or white, and tube yellow.

Palmer found this plant abundant under brush and in protected places in the "middle" of the island (Watson 1876:118). It now grows in grassy and rather bare places, mostly at 400 to 1000 m but lower in the canyons, from the pine ridge and cypress grove to El Picacho, in good years locally abundant.

The type is *Palmer 79* in part (where?), from Guadalupe Island. Grant (1959:137) also referred here *G. guadalupensis* Brand, based on *Palmer 79* in part. Raven (1963:334) separated the mainland material as ssp. *continentalis*.

Polygonaceae

NOTE. — For *Harfordia macroptera* see Excluded Species, p. 169.

Eriogonum zapatoense Moran, Trans. San Diego Soc. Nat. Hist. 15:267. 1969

Eriogonum molle of Guadalupe Island references.

RANGE. — Endemic to Guadalupe Island: known only on Outer Islet.

This is a shrub, with trunk to 1 dm thick, densely tomentose herbage, and 4–8 times trichotomous cymes of yellow flowers (Fig. 72). In protected places it may grow erect,

FIGURE 71. *Camissonia robusta* above Northeast Anchorage, 25 March 1973. Now common where every early botanist came ashore, it was not found until 1948. Can it be native?

FIGURE 72. The endemic *Eriogonum zapatoense* (*M18170*) on Outer Islet, 21 August 1970. This shrub has never been found on the main island.

but most plants are prostrate, commonly with the trunk or the few main branches running zigzag up slope, so that the plant is strongly asymmetrical, in many larger plants the lower branches dead and the foliage clustered at the top.

This shrub is common on the inner slopes of the crater, especially the south slope, and occasional in the upper valley, of Outer Islet, sometimes known as Islote Zapato. From sterile plants found in 1948, Moran (1951:154) reported it as *E. molle* Greene. It is most similar to *E. molle*, which is endemic to the north end of Isla Cedros, and to *E. giganteum* S. Watson, of Santa Catalina, San Clemente, and Santa Barbara Islands, California. In leaf shape especially, it resembles *E. giganteum* ssp. *formosum* (K. Brandegee) Raven, of San Clemente Island. Both *E. molle* and *E. giganteum* grow erect, and *E. giganteum* often much taller; and both have somewhat thinner leaves, commonly taller and stouter peduncles, and much larger and, especially in *E. molle*, denser cymes, with pubescent pedicels, and with white or pink rather than yellow flowers. The holotype is *Moran 15114*, collected 21 June 1968 (SD67852).

Pterostegia drymarioides Fisch. & C. A. Mey., Ind. Sem. Hort. Petrop. 2:48. 1835.

RANGE. — California to Utah, Arizona, and NW Baja California; islands of southern California and south to Cedros.

Palmer found this plant in the shade of rocks in the "middle" and more rarely at the "south end" of the island (Watson 1876:119). It grows among rocks throughout the island, from the north slope to the south end and from sea level to the top of Mt. Augusta and El Picacho, often rather common but less so at the south end.

Portulacaceae

Calandrinia ciliata (Ruiz & Pav.) DC., Prod. 3:359. 1828.

Calandrinia menziesii Hook., Fl. Bor. Amer. 1:223. 1834.
Calandrinia ciliata (Ruiz & Pav.) DC. var. *menziesii* (Hook.) J. F. Macbr., Field Mus. Bot. Ser. 11:20. 1931.

RANGE. — British Columbia to Arizona, Sonora, and central Baja California; South America; islands of southern California and Islas Todos Santos and San Martín.

Palmer found this plant in moist spots in the open valleys all over the island, growing in masses (Watson 1876:113). Greene (1885:221) remarked that it was much smaller than in California, always prostrate, an albino form very frequent. It is now one of the common plants of grassy slopes from shore to summit in the northern part of the island and extends to the south end in damp arroyo beds.

Cistanthe guadalupensis (Dudley) Carolin in Hershkovitz, Phytologia 68:269. 1990.

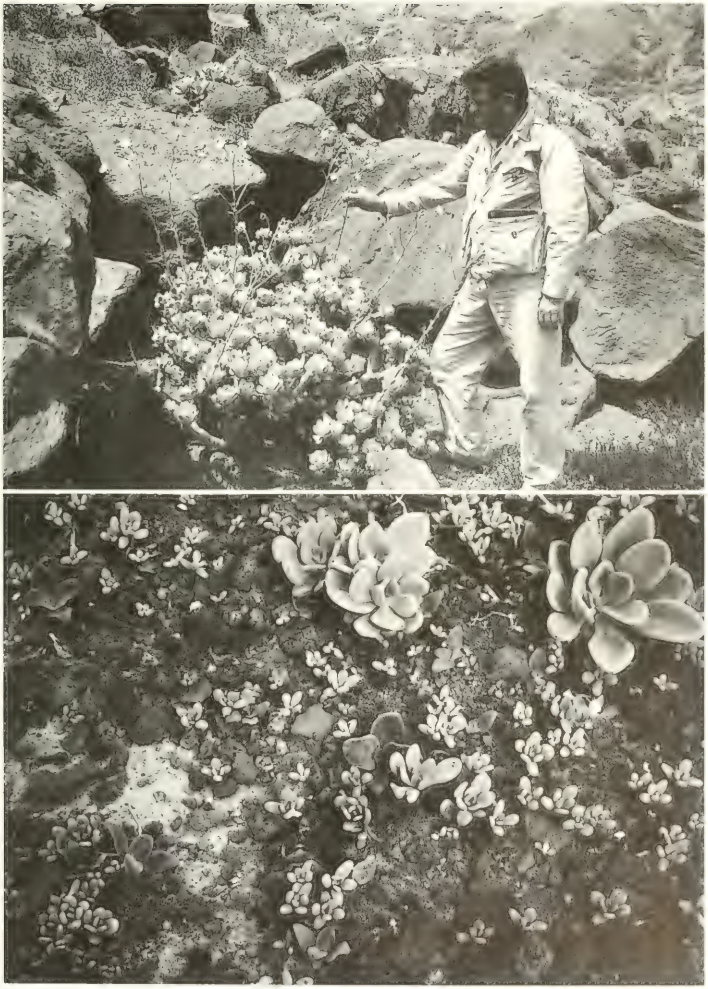
Talinum guadalupense Dudley in Jordan, Fur Seals and Fur-seal Islands N. Pacific Ocean, Part 3, p. 282. 1899.

RANGE. — Endemic to Guadalupe Island.

Succulent shrub to 8 dm high when not in flower and to 18 dm wide, summer-deciduous in dry sites, the stem to 11 cm thick at base, branching from base and above, the lower branches in large plants sprawling; bark smooth, brown, usually with dull silvery sheen, with slight tendency to peel in papery layers; ultimate branches blunt at apex, crowned

with leaf rosette, 1.5–4 cm thick below rosette, the leaf scars irregular, lunate to rhombic, 6–14 mm wide, 3–6 mm high, the bundle scar elliptic, 2–3 mm wide, 1.5–2 mm high. Rosettes lax, 0.5–2 (–3.5) dm wide, of 10–35 (–55) leaves, only the youngest close-set, the older separated by areas of stem greater than those they cover. Rosette leaves obovate to obovate-cuneate, rounded to truncate or emarginate at apex and usually apiculate, 3–10 (–17) cm long, 3–5 (1.5–8.5) cm wide, 3–7 mm thick, bluish glaucous, the margins obtuse, often purple-red. Floral stems terminal, 1–5 (–9) dm tall, 3–12 mm thick at base, bearing 12–20 scattered bracts and, from axils of upper ones, 3–10 spreading to ascending mostly simple branches 3–10 cm long, each ending in a crowded cincinnus or sometimes two or rarely several; panicle 1–3 dm high, 1–2.5 dm wide. Lower bracts like reduced foliage leaves, those of inflorescence thin, broadly ovate, acutish, cupped, keeled, yellow-green with conspicuous purple-red veins, 3–10 mm long, 3–8 mm wide, usually drying persistent. Cincinni circinate in bud, of 5–13 flowers, the axis conspicuously jointed, its segments mostly 3–5 mm long, or the lower longer, 1.5–3 mm thick at base, 2–4 mm thick at apex, each seated in hollow in axil of sheathing bract. Pedicels 2–5 mm long, 1–3 mm thick at base, thickening upward, each with small basal bract and shallow basal constriction, where abscission may later take place. Buds ovoid to subglobular, rounded at apex, to 9 mm long and 8 mm thick. Flowers (Plate 2J) at least Jan.–June, 2.5–4.5 cm wide, opening mostly two days and partially closing at night, subperigynous, the stamens and petals inserted on edge and outer shoulder of cup 1–2 mm high closely surrounding base of ovary. Sepals 2, broadly ovate to reniform, rounded at apex, imbricate in bud, 6–10 mm long, 7–13 mm wide, colored and marked like bracts, persisting in fruit. Petals 5 (–7), imbricate, rotately spreading to slightly upcurved, rose pink to almost white, obovate, often cuneate at base, subtruncate to emarginate, erose, 13–23 mm long, 10–22 mm wide, connate ± 0.5 mm. Stamens 70–105, the filaments pale to deep rose, 8–14 mm long, the outer filiform, glabrous, the inner thickened and connivent in lower fourth and there bearing colorless clavate unicellular hairs to 1 mm long, concealing ovary; anthers cream to deep rose, oblong, 1.2–2 mm long, 0.5–0.7 mm wide, maturing in centrifugal order, the two thecae rather weakly united, free in lower half and upper fourth. Gynoecium mostly 3-merous; ovary free, subglobular, 2–3 mm thick, with 3 (2–4) low vertical ridges alternating with faint grooves; style white, 10–16 mm long, tapering from ± 0.4 mm thick at base to ± 0.8 mm thick at apex; stigmas 3 (2–4), spreading, oblong, rounded at apex, 1.5–2 mm long, ventrally papillose, the papillae ± 0.1 mm long and a fourth as thick. Capsule cartilaginous, brown with oily lustre, triangular-ovoid, 6–8 mm long, 5–6 mm thick, capped nearly to maturity with dark purple corolla remnant, splitting nearly to base, the valves triangular, subacute. Seeds numerous, lenticular, strophiolate, finely low-mammillate, dark red-brown and somewhat shining but largely covered with scurf, 0.9–1.2 mm long, 0.8–1.0 mm wide, 0.5–0.6 mm thick, the raphe rather acute, the opposite edge rounded. Chromosome number: $n = 48$ fide Sherwin Carlquist.

Botanists of the fur seal expedition were first to find this curious succulent shrub (Dudley 1899); the specimen is noted as "in valley, south end of island." Thirty years later a single living plant, found by Steve Glassell and Bill Pemberton, reached Eric Walther, who showed first the sterile plant (1932), then (1937) the flowering plant with an identification. Howell (1942:148) saw what he took to be this plant "on rocks inaccessible to goat and man" near Northeast Anchorage. Moran and Lindsay (1950) found it plentiful on Outer Islet (Figs. 34, 75) and on a black lava rock just off the landing at the southwest corner of the island; and Lindsay (1951) showed several fine photographs of it on this rock and told its remarkable story. It is common also on Islote Negro (FRONTISPIECE, Figs. 73, 74)(Moran 1959, figs. 21–23). In fact, after four days circumnavigating the island in a small launch in search of fur seals, George Lindsay wrote me in 1955 that it grows on



FIGURES 73 and 74. The endemic *Cistanthe guadalupensis*, rare on the main island, common on Islote Negro (see FRONTISPIECE). FIGURE 73. The largest shrub seen (*M5991*), with Dr. Carl Hubbs, 19 April 1957. FIGURE 74. The abundant seedlings (with a few of *Mesembryanthemum crystallinum*), 10 February 1957.

FIGURE 75. *Cistanthe guadalupensis* on Outer Islet, leafless for the summer, 21 June 1968.

rocks pretty well around the island. On the main island it is occasionally seen on seacliffs, but it is very rare in more accessible places such as the edge of the south-end mesa.

Dudley (1899) said nothing about the generic position of this plant, and until recently no one has questioned his placing of it in *Talinum*. From the dried specimen he called the thickened stem a fusiform fleshy root, perhaps thinking it analagous to the tuberous stems of various American species of *Talinum*, and called the leaves all radical. Wilson (1932) and von Poellnitz (1934) could add little to the description and kept the species in *Talinum*. The true nature of the stem became known only when the plant was rediscovered and was illustrated and variously redescribed (Walther 1932, 1937; Moran and Lindsay 1950; Lindsay 1951; Byles 1957). In fact, Hershkovitz (1992) still called the leaves all basal.

Although Eastwood (1929:404) formally listed this plant as *Talinum guadalupense*, she also mentioned it (p. 396) as a species of *Calandrinia*. Walther (1937) commented on the similarity of the flowers to those of "the well-known *Calandrinia discolor* Schrad. from Chile," and I have been impressed with its overall similarity to the Chilean plant grown in California as *C. grandiflora* Lindl. Carolin decided its relationships were indeed with the Chilean plants (Hershkovitz 1990). Surprisingly, the superficially very different annual *Calandrinia maritima*, which happens also to grow on Guadalupe Island as well as on the mainland, also belongs to *Cistanthe* section *Cistanthe*.

Carlquist (1965, fig. 8–13) showed a large plant and a flower of *C. guadalupensis* and briefly discussed its unusual growth form. Carlquist (1974:399, fig. 10.15) showed the plant and flower and, with a transection and a tangential section of the secondary xylem, discussed parenchymatization of the xylem.

Cistanthe guadalupensis throve in the garden of Dr. Carl Hubbs in La Jolla, California, within sight of the sea, flowering handsomely most of the year and coming freely from seed. It is widely admired among fanciers of succulent plants and still sometimes grown, though they often consider it hard to grow (Rowley 1978, 1987).

Cistanthe maritima (Nutt.) Carolin in Hershkovitz, Phytologia 68:269. 1990.

Calandrinia maritima Nutt. in Torr. & A. Gray, Fl. N. Amer. 1:197. 1838.

RANGE. — Coastal southern California to central Baja California; most islands of southern California and NW Baja California, to Isla Cedros.

Brandegee (1900:22) was first to report this plant from Guadalupe Island but gave no specific locality. It seems to be scarce and local on the east side of the island just below the middle, as near the lobster camp. Others of Brandegee's additions to the known flora are rather local in this part of the island.

Claytonia perfoliata Willd. ssp. ***mexicana*** (Rydb.) J. M. Mill. & K. L. Chambers, Novon 3:269. 1993.

Limnia guadalupensis Rydb., N. Amer. Fl. 21:311. 1932.
Claytonia perfoliata and *Montia perfoliata* of Guadalupe Island references.

RANGE. — Central California to Guatemala; islands of southern California to Cedros.

Palmer found this plant all over the island, in masses on the shaded side of rocks or logs or in deep ravines (Watson 1876:113). Franceschi (1893c:134) found it quite common from centre to north, most luxuriant under the palms, where it was in flower early in December. It is now rather common among rocks and in other shaded spots, widespread from shore to summit in the northern half of the island and to El Picacho, sometimes lush and abundant.

Rydberg based *Limnia guadalupensis* on Palmer's collection (No. 15) of 1875 (NY). From the key and description it would appear to differ from related species in the shape of the basal leaves and in the small size of the plant as a whole and especially of its stem leaves, inflorescence, and seeds. However, the type sheet has not only three very small plants but also one large one, clearly of the same collection. Howell (1942:148) remarked that this plant was almost invariable on the island, and clearly there is only one species though here as elsewhere the size varies greatly. Large plants (e.g. *M6600*) may be as much as 3.5 dm tall, with basal leaves to 4 cm wide, the disk of stem leaves 7.5 cm wide, and the inflorescence 14 cm long. Greene (1885:221) remarked that the corolla of the island plant was smaller and more purple than in California plants. Corollas are about 2–3 mm long, which is a little small for the species, and I would say deep pink rather than purple. The seeds are about 0.95–1.3 mm long, which again is rather small for the species.

Miller (1978) reported from chromosome counts of 235 populations that *Claytonia perfoliata* s. l. is a polyploid pillar complex based on three morphologically different and geographically defined diploids and having five levels of ploidy.

Primulaceae

†****Anagallis arvensis*** L., Sp. Pl. p. 148. 1753.

RANGE. — Native to Europe; a widespread weed in North America.

Palmer found only three plants, in a gravelly place near the beach on the east side (Watson 1876:117). Greene (1885:225) saw only one plant, on top of the island. No one has found it since, and evidently it never became well established.

Dodecatheon clevelandii Greene ssp. ***insularis*** H. J. Thomps., Contr. Dudley Herb. 4:134. 1953.

Dodecatheon meadia of Guadalupe Island references.

RANGE. — Inner south coast ranges of California to San Miguel, Santa Rosa, Santa Cruz, Anacapa, San Nicolas, Santa Catalina, San Clemente, and Guadalupe Islands.

Palmer found this plant very abundant on moist rocky slopes at the "south end" and "middle" of the island and noted that goats were very fond of it (Watson 1876:117). Franceschi (1893c:136) found robust large-leaved specimens, most abundant only between the trail to the cabins and the cliff, the finest on the very ridge. He remarked that goat hunters, short of tobacco and attracted by the leaves, used them as a substitute and said they had a most pleasant flavor.

Between the goats and the goat hunters, the plant is now scarce, a few small colonies seen scattered on the northeast slope of El Picacho at 500–800 m and one or two plants on the cliff of the Lower Circus and on its brink. Most plants seen were sterile, only one on a cliff having some old flowers 21 March 1974 (*M21166*). From Guadalupe Island, Thompson (1953:133) cited *Anthony 245* and *Palmer 55*.

Ranunculaceae

Myosurus minimus L. var. ***filiformis*** Greene, Bull. Calif. Acad. Sci. 1:277. 1885.

Myosurus minimus of Guadalupe Island references.

RANGE. — Northern California to NW Baja California.

Greene (1885:220) found this plant at the middle of the island and also at the north end, near springs. Campbell (1952:394) cited Greene's specimen of April 19, 1885, (GH) and called Guadalupe Island the type locality. Apparently it has since been collected on the island only once, in 1958 (*Wiggins and Ernst 33*), on the upper northwest slope of the pine ridge at 600 m. Thus it is rare in accessible places, but the foggy northwest cliffs probably have suitable habitats where it may survive.

Ranunculus hebecarpus Hook. & Arn., Bot. Beechey Voy. p. 316. 1840.

RANGE. — Washington and Idaho to NW Baja California; Santa Catalina and Cedros Islands.

Palmer found this plant abundant on warm slopes in the "middle" of the island (Watson 1876:112). Greene (1885:220) found it only in the shade of a large tree. It is now widespread and locally common on the northwest slope at 500–800 m and more rarely seen as far south as the spring.

Greene thought the island plant shorter and stouter than the California plant, the achenes more numerous. However, Benson (1948:111) cited the collections of Palmer and Greene as *R. hebecarpus*.

Resedaceae

Oligomeris linifolia (Vahl) J. F. Macbr., Contr. Gray Herb. 53:13. 1918.

Oligomeris glaucescens and *O. subulata* of Guadalupe Island references.

RANGE. — Southern California to Texas and Mexico; islands of southern California to Cedros, San Benitos, and Natividad; also Old World.

Palmer found this plant in deep warm canyons and ravines in the "middle" of the island and occasionally at the "south end" (Watson 1876:113). It is occasional to locally common at low elevations throughout the island but especially in the southern half, including Islote Negro and Outer Islet. Some authors treat it as an introduction in the New World.

Rhamnaceae

†***Ceanothus crassifolius*** Torr., Pacif. Railr. Rep. 4:75. 1857.

Ceanothus crassifolius Torr. var. *planus* Abrams, Bull. New York Bot. Gard. 6:415. 1910.
Ceanothus perplexans of Guadalupe Island references?

RANGE. — Southern California to NW Baja California.

Palmer found only three alive, at the base of Mt. Augusta (Watson 1876:114). Greene (1885:222) saw only a small seedling, near the cabins. Franceschi (1893c:134) found one plant alive near the center of the island west of Mt. Augusta among the cypresses, "surrounded by what appeared to be the dead stumps of thousands of its brethren, which must have formed a thick and general underwood not only in the larger cypress grove but also in the smaller near the springs and cabins." "Twelve to fifteen feet high." Later he found three or four more living plants in the upper grove. No one has found this shrub since, and undoubtedly it is extinct on the island.

Under var. *planus*, McMinn (1942:234) cited Guadalupe Island, *Dr. F. Franceschi 1332* in 1893.

†***Ceanothus cuneatus*** (Hook.) Nutt. in Torr. & A. Gray, Fl. N. Amer. 1:267. 1838.

RANGE. — Oregon to NW Baja California.

Palmer found only three nearly dead specimens, among rocks in the "middle" of the island (Watson 1876:114). No one has seen it since, and undoubtedly it is extinct on the island.

Rhamnus pirifolia Greene, Pittonia 3:15. 1896.

Rhamnus crocea Nutt. ssp. *pirifolia* (Greene) C. B. Wolf, Mon. Rancho Santa Ana Bot. Gard. 1:45 1938.
Rhamnus crocea of Guadalupe Island references.

RANGE. — Endemic to San Miguel, Santa Rosa, Santa Cruz, Santa Catalina, San Clemente, and Guadalupe Islands.

Shrub to 2 m high and 5 m wide or hanging from cliff to 4 m; trunk to 1.5 dm thick.

Palmer found only six shrubs, growing in the crevices of high cliffs in the "middle" of

the island, in bloom April 6 (Watson 1876:114). About that many have survived until recent times, scattered on cliffs in the northeast part of the island: two in Oak Canyon at 850 m (*M12032*) and 900 m (*M12036*); Barracks Canyon at 420 m (*M7829*); north rim of Barracks Canyon at 500 m (*M13803*); Esparsa Canyon at 250 m (*M5964*). In May 1971 I saw what appeared to be this shrub on a high cliff at 675 m near the middle of the northwest end of the island. From Guadalupe Island Wolf (1938:46) cited *Anthony 261*, *Hanna* (CAS), and *Mason 1528*.

Rosaceae

Aphanes occidentalis (Nutt.) Rydb., N. Amer. Fl. 22:380. 1908.

Alchemilla occidentalis Nutt. ex Torr. & A. Gray, Fl. N. Amer. 1:432. 1840.

RANGE. — Washington to NW Baja California; Santa Rosa, Santa Cruz, Santa Catalina, and San Clemente Islands.

Palmer found this plant among rocks and sage brush at the north end and also around a spring (Watson 1876:114). This inconspicuous little plant is widespread on the northwest slope of the island and the northeast ridge, from 500 to 1100 m, and fairly common locally.

Robertson (1974) wrote that [subgenus] *Aphanes* "probably was confined to Europe before western man began his explorations of the world." However, there seems no question that this is native in western North America and on Guadalupe Island.

†***Heteromeles arbutifolia*** (Lindl.) M. Roem. var. ***macrocarpa*** (Munz) Munz, Aliso 4:92. 1958.

Photinia arbutifolia Lindl. var. *macrocarpa* Munz, Bull. S. Calif. Acad. Sci. 31:64. 1932.

RANGE. — Endemic to Guadalupe and San Clemente Islands?

The late Guadalupe Island population of one may be described as follows. Tree ± 5 m tall, with one arching branch 7 m long; trunk 2 dm thick at base. Young stems and young leaves densely tomentose with simple slender crisped white hairs ± 1 mm long, a few of which persist in age. Leaf blades elliptic, mostly obtuse and mucronate at apex but some acute or rounded, cuneate at base, 4–9 cm long, 1.5–4 (–5.7) cm wide, mostly 2.2–2.6 times longer than wide, the margins revolute, subentire or mostly weakly crenate-dentate, with 10–18 crenations on each side, when young with subulate red glandular teeth ± 0.4 mm long; petioles 12–27 mm long. Inflorescence to 16 cm wide. Petals white, spreading to spreading-ascending. Young fruit obovoid-truncate, slightly angled, to 9.5 mm thick.

Wiggins (1980:793) reported the species as once common on Guadalupe Island but now virtually exterminated by the goats, a few spindly shrubs persisting on inaccessible cliffs, mostly at the north end of the island. However, I have seen no specimens or other records to support this statement. I have seen only a single tree, arching out from a sheer arroyo wall, at 70 m, just northwest of the lobster camp on the southeast coast. Specimens of December 1957 (*M6452*; *Newcomb 184*, UC) bear a few flowers and some immature fruit, to 9.5 mm thick according to Newcomb's notes, though I noted them only as 6 mm long; specimens of April 1958 (*Carlquist 484*, *Wiggins and Ernst 202*) have immature inflorescences. The tree had disappeared by 1970, and the species probably is now extinct on the island. Dr. Wiggins wrote me in 1958 that Dr. Hanna said he had seen the same

tree in 1922, but no specimen could be found at CAS.

This plant is notable for its broad, obtuse, nearly entire leaves, the blades mostly 2.2–2.6 times longer than wide; an exceptional leaf is 8.2 cm long by 5.7 cm and so less than 1.5 times longer than wide. In typical mainland specimens the leaf blades commonly are narrower and acute and almost always are sharply serrate. Also, the young herbage in the Guadalupe specimens is exceptionally pubescent. All together, these specimens thus look quite different from typical mainland material: in fact, several able botanists (R. Bacigalupi, L. Benson, A. Carter, J. T. Howell, P. A. Munz, R. F. Thorne), all well acquainted with *H. arbutifolia*, failed to recognize sterile specimens.

Mainland collections of *H. arbutifolia* vary widely in leaf shape. The blades commonly are acute, 1.5–3 cm wide, and 3–4 times as long, though specimens with broader or more obtuse blades occur sporadically but rather widely through the range. The teeth vary in size but are rarely so reduced as in the Guadalupe plant; and generally no correlation is evident between width of leaf and size of teeth. Pubescence also varies, usually with no evident correlation with leaf width or size of teeth; very few specimens are as tomentose as those from Guadalupe Island.

However, some collections of *H. arbutifolia* from the Cape Region of southern Baja California have leaves obtuse to rounded, to 6 cm wide (*R. K. Peters 248*, UC, from La Laguna), some with the teeth small or subobsolete; at least some have young growth tomentose; and at least some have large fruits. At La Laguna I collected from two shrubs growing side by side (*M7434A*), both with young growth tomentose, one with leaves 2–3 cm wide, the other with leaves mostly 3–5.7 cm wide.

Munz (1932) proposed var. *macrocarpa* for trees of San Clemente and Santa Catalina Islands, on the basis of fruits 8–10 mm long rather than 5–6 mm long. Raven (1963:324) reserved judgement on the variety, unconvinced that the fruit was uniformly large in the populations of these two islands; and he reported large fruit on some specimens from Santa Cruz and Santa Rosa Islands. Although Thorne (1967:63) likewise did not recognize the variety, he wrote that in general the specimens of Catalina Island did seem to have larger fruits. These authors also referred to tree-like size.

Discussion of var. *macrocarpa* thus far had centered on size of fruits and had not mentioned the leaves. However, after Dr. Munz had seen the Guadalupe specimens, he wrote (1974:747), "There is a tendency for insular plants to have lvs. subentire, [and he went on] the frs. red, 8–10 mm long, and these constitute a possible var. *macrocarpa* (Munz) Munz. . . . Judging from their behavior in the botanic garden, they are not only more showy, but less readily eaten by birds." In the holotype, from San Clemente Island (*Munz 6759*, POM 18981), the leaves are obtuse and 2–3 times as long as wide; leaf serrations on one branch are rather small and on the other subobsolete. A near topotype (*Raven 17985*, RSA, SD) is very similar in leaf shape and margins to the Guadalupe specimens. In most San Clemente specimens the leaves are rather wide for their length, some 5 cm wide, but a few are strongly serrate. Most are like average mainland specimens in pubescence, but a few are markedly pubescent.

Trask (1899) remarked that on Catalina Island the leaves of *H. arbutifolia* were usually entire, sharply serrate ones occurring but rarely, often not one such leaf on a slope covered with this species. In fact, this seems an overstatement; for many collections, including some with large fruit, have sharply serrate (and rather narrow) leaves, similar to average mainland material. Although some have broad leaves and reduced or subobsolete teeth, the tendencies seem weaker here than on San Clemente Island. Among specimens from

Santa Cruz and Santa Rosa Islands, where Raven noted some large fruit, some have narrow and sharply serrate leaves; but again there is some tendency to reduction of teeth and a greater tendency to greater leaf width. One Ralph Hoffmann collection (SBBG) from Santa Rosa Island has one leaf blade 15 cm long and 7.9 cm wide! On Isla Cedros most plants, from canyons on the east side, have the leaves narrow, acute, and sharply serrate; but one collection (*M18432*), from under the pines 3 km from the north end, has some leaves to 4 cm wide and obtuse, some with much reduced teeth. Since many of these insular collections lack fruit, it is not clear what proportion of the plants have large fruit or to what extent leaf characters are correlated with large fruit. One specimen from Sierra de San Francisquito in the Cape Region (*T. S. Brandegee 205*, UC) Tatemi Shimizu annotated as var. *macrocarpa*.

Although the known population of Guadalupe Island may be called remarkably uniform, nothing is known of former variation. Perhaps the Guadalupe plant is a relict that persisted in a relatively pure state on this most isolated island, persists with some admixture of the mainland form on less isolated San Clemente Island, and has more nearly been swamped out on the continental Santa Catalina, Santa Cruz, Santa Rosa, and Anacapa Islands. Dr. Daniel Axelrod wrote me that he knew of no fossils of this form. It seems well treated as a subspecies (or variety) on Guadalupe and San Clemente Islands, even though it becomes more of a taxonomic embarrassment on the northern islands and in the Cape Region.

Rubiaceae

Galium angulosum A. Gray, Proc. Amer. Acad. Arts Sci. 11:74. 1876.

RANGE. — Endemic to Guadalupe Island.

Dense, much branched, probably dioecious, dark green shrub to 8 dm wide and projecting nearly as far from cliff, with long slender woody branches spreading to pendent, bearing dense annual tufts of new vegetation at nodes; stems 4–8 ribbed, the stems and leaves sparsely hispid with short or long straight spreading hairs. Leaves 4 or often 6 in a whorl, mostly 3–7 mm long, 1-nerved, spreading or often reflexed, elliptical or obovate, narrowed gradually to base, obtuse or round at apex, tipped with long weak hair; glandular cells apparently none. Flowers in April and May, apparently few, solitary at ends of lateral branches; corolla rotate, yellow-green, glabrous or rarely hispid; ovaries glabrous or rarely with a few hairs like those on stems and leaves. Fruit in October, fleshy, glabrous, whitish, translucent, 2.5–3.5 mm thick, the mericarps not separating, becoming shiny black and wrinkled when dry. Chromosomes: $2n$ = ca. 66. (Description based on that of Dempster 1978:10)

Palmer found only a single small scrubby plant, in a crevice of a high cliff in the "middle" of the island (Watson 1876:115). Though not reported since, it has persisted until recently as a very rare plant on cliffs in the northeast part of the island. In 1957 I found two plants on a cliff at 450 m on the north rim of Barracks Canyon at the mouth (*M6117*) but in 1960 failed to find them again. Also in 1957 I found a single plant at 250 m on a cliff on the south side of Esparsa Canyon (*M6136*), and it was still there in 1970 on my last visit to that spot.

Dempster (1978:10–11) thought this plant probably closest to the fleshy fruited dioecious species of California. In buds collected from the Esparsa Canyon plant in May 1967 (*M13802*), she found $2n = \pm 66$; she was rather sure that it was hexaploid. She noted that

all flowers seen had well-developed pistils and abortive stamens. She added that most material had 4 leaves at the great majority of nodes, though the type had 6 at most nodes. And the type was unique also among the six collections she had seen in having hispid corollas.

****Galium aparine*** L., Sp. Pl. p. 108. 1753.

RANGE. — Widespread in North America, commonly thought to be introduced from Europe; islands of California.

Palmer found this plant common on warm shady hillsides in the "middle" and more rarely at the "south end" (Watson 1876:115). It is widely distributed in the northern half of the island, as far south as Juniper Canyon, and is fairly common about rocks in the canyons, at the foot of cliffs, and on the northwest slope of the island.

Rutaceae

****Ruta chalepensis*** L., Mant. p. 69. 1767.

Ruta graveolens of Guadalupe Island references.

RANGE. — Native of southern Europe; widely grown and often escaping.

In 1948 three sterile plants grew in the canyon mouth at Northeast Anchorage (Moran 1951:160). In 1965 a colony of a dozen grew on the south bank of the arroyo at 20 m (*M12019*), so the plant is reproducing but not spreading rapidly.

Saxifragaceae

Jepsonia malvifolia (Greene) Small, Bull. Torrey Bot. Club 23:19. 1896.

Heuchera ? and *Jepsonia parryi* of Guadalupe Island references.

RANGE. — Endemic to Santa Rosa (type locality), Santa Cruz, San Nicolas, Santa Catalina, San Clemente, and Guadalupe Islands.

Woody caudex 5–7 cm high, branching horizontally to form a clump to 15 cm long and 10 cm wide, the branches mostly 1.5–2 cm thick, abruptly narrowed upward to short stem ± 5 mm thick bearing leaves and peduncles. Leaves 1–2, appearing in October, fragrant, the petiole at first pink, 3–7 cm long, 1.5–3 mm thick, the blade at first funnelform and to 6 cm wide. Peduncles 1–3 from one stem, at different stages, 14 cm tall, 2 mm thick at base, densely glandular-pubescent, with bract ± 5 cm above base; cyme 2–3 cm wide, of ± 20 flowers on several lax cincinni, or with subsidiary cymes below. Flowers August to October, on pedicels 1–2 mm long. Hypanthium subcampanulate, subpentagonal, subtruncate at base, glandular-puberulent, the tube ± 2 mm long, greenish with 10 dark red veins, the calyx lobes erect, triangular-ovate, rounded, 1–1.2 mm long by 1.2–1.5 mm. Corolla 7–8 mm wide, the petals outcurved, ovate, rounded, 3–3.5 mm long, ± 2.5 mm wide, white veined dorsally with pink becoming purplish red, the stipelike base ± 0.4 mm wide. Filaments white, erect, 2–3 mm long, the anthers purplish. Gynoecium whitish, 2 mm high, the styles short, indefinite. (Fig. 76)

Palmer found a single plant, not in flower, in the crevice of a rock (Watson 1876:114); Franceschi (1893c:135) likewise found but one; and Greene (1885) omitted it from his

FIGURE 76. The insular endemic *Jepsonia malvifolia* (*M12064*), from lower east slope of El Picacho at 350 m; flowering in San Diego 1 October 1972. It grows also on five of the Channel Islands.

list, in which he intended to include Palmer's findings as well as his own. Moran (1951:160) found sterile plants on a cliff at the north end, which flowered in cultivation. Despite early reports or lack of them, the plant is widespread and sometimes locally common, especially on north cliffs and in deep soil among rocks on north slopes, from the north end to the gray peak south of El Picacho and to the east slope above the southeast sealing camp, at least from 100 to 800 m.

Scrophulariaceae

NOTE. — For *Galvezia juncea* see Excluded Species, p. 169.

Antirrhinum nuttallianum Benth. ssp. ***subsessile*** (A. Gray) D. M. Thomps., Syst. Bot. Monogr. 22:95. 1988.
Antirrhinum subsessile A. Gray, Bot. Gaz. 9:54. 1884

Antirrhinum pusillum Brandegee, Univ. Calif. Publ. Bot. 6:360. 1916.
Antirrhinum nuttallianum Benth. forma *pusillum* (Brandegee) Munz, Proc. Calif. Acad. Sci. Ser. 4, 15:359. 1926.
Sairocarpus pusillus (Brandegee) D. A. Sutton, A revision of the tribe Antirrhineae, p. 466. 1988.

RANGE. — Coastal southern California to south central Baja California; San Miguel, Santa Rosa, Santa Cruz, Anacapa, Santa Catalina, Los Coronados, Todos Santos, San Martin, and Cedros Islands; Arizona.

Palmer found this plant rather rare in deep warm canyons in the "middle" of the island (Watson 1876:117). It is widespread on the island but rather uncommon, often no more than one or two seen at a time. The small cleistogamous forma *pusillum* likewise is widespread but not common, as often as not the two occurring together. Thompson (1988:98) found experimentally that the cleistogamous condition of forma *pusillum* may be induced by suboptimal growing conditions and is easily reversible.

Antirrhinum watsonii Vasey & Rose, Proc. U. S. Natl. Mus. 11:533. 1889.

Antirrhinum kingii S. Watson var. *watsonii* (Vasey & Rose) Munz, Proc. Calif. Acad. Sci. Ser. 4, 15:367. 1926.
Sairocarpus watsonii (Vasey & Rose) D. A. Sutton, A revision of the tribe Antirrhineae, p. 471. 1988.

RANGE. — Central Baja California to western Sonora and southernmost Arizona; Islas Cedros and San Benitos.

This plant was first found on the island in 1957 (*M5632*, *M5987*, *M6157*). It is widespread but not common at low elevations in the southern part, from the lobster camp and West Anchorage southward and on Outer Islet. Thompson (1988:104) reinstated it as a species, citing *M5987* and *M17345* from Guadalupe Island. Dr. Thompson in 1986 annotated six of my Guadalupe collections.

Castilleja attenuata (A. Gray) T. I. Chuang & Heckard, Syst. Bot. 16:656. 1991.

Orthocarpus attenuatus A. Gray, Pacific Railr. Rept. 4:121. 1857.

RANGE. — Vancouver Island to NW Baja California; Santa Cruz Island; also central Chile, where possibly introduced.

This plant has been found only one place on the island, first in 1967: locally common in seep on northwest slope between the old lookout and Hemizonia Cliff, at 800 m (*M13821*). I have not found it there in drier years.

†ϕ***Castilleja exserta*** (A. Heller) T. I. Chuang & Heckard, Syst. Bot. 16:657. 1991.

Orthocarpus purpurascens Benth., Scroph. Indicae. p. 13. 1835. Not *Castilleja purpurascens* Greenm.

RANGE. — California to Arizona, Sonora, and northern Baja California; San Miguel, Santa Rosa, Santa Cruz, and Santa Catalina Islands.

Brandegee (1900:22) is the only one to have found this plant on Guadalupe Island, and Keck (1927:541) cited his specimen as *Orthocarpus purpurascens typica*. Because it is a west American plant that also grows on the four northern islands in a familiar pattern, it might be easy to accept as native on Guadalupe. Without explanation, however, Brandegee

called it "introduced" — though his assertion is unconvincing because he said the same of *Lasthenia californica*, which seems clearly to be native. The fact that the plant has not been found before or since suggests that it may indeed be a waif that never became established. Since there is no way of knowing, I list it as possibly introduced on the island (Table 2).

Castilleja fruticosa Moran, Trans. San Diego Soc. Nat. Hist. 15:283. 1969.

Castilleja guadalupensis of some references.

RANGE. — Endemic to Guadalupe Island, at the south end and on Outer Islet.

This is a woody perennial 2–5 or rarely 9 dm high and to 5 dm or more wide, with glandular-puberulent to somewhat villous light green herbage, the bracts and calyx tipped with Indian orange.

This plant grows on a barren volcanic mesa and in two craters near the south end of Guadalupe Island, in an area of low rainfall but of frequent fog. In 1948 I found it on the inner slope of the crater of Outer Islet (Moran 1951:159) but failed to find it on the main island, even though I collected at the very spot on the mesa where its bright flowers were conspicuous in later years. Earlier collectors at the south end also had failed to find it. Until the founding of the weather station in 1946, enough goats evidently came to the south end to keep certain plants near the point of extinction; but goats have since come more at their peril, and the plants have gained some slight protection. In 1957 I did find *C. fruticosa* on the mesa above the station but saw only herbaceous plants, looking almost like annuals. In 1967 and later, some plants were small shrubs with woody stems to 2 cm thick. In 1957 it extended as far north as the inner slope of the crater of Plaza de Toros, at 320 m (*M6479*), though in 1970 I failed to find it there. These facts suggest that in 1957 *C. fruticosa* might recently have colonized the main island from one of the nearby islets and that the extent of the colony has since varied with the years depending on goat damage. The number of goats coming to the south end, and the damage they do, must vary from year to year, depending on pressures farther north.

Castilleja fruticosa, though still herbaceous at first flowering, is remarkable for the thick and hard woody stems of older plants. Apparently it is one of the woodiest of the genus. Perhaps in relation to the maritime habitat, the foliage leaves are quite thick and somewhat succulent. The capsules are unusually hard and woody and are distinguished by a depression on the under side, which sometimes becomes a deep transverse groove. Capsules from past years often persist on dead inflorescence axes, mostly still unopened and still holding seeds. Such seeds proved viable, and from seedlings (*M13768*) Larry Heckard got a chromosome count of $n = 12$ (Chuang and Heckard 1993).

Castilleja guadalupensis Brandegee, Zoe 5:166. 1903.

Castilleja foliolosa of Guadalupe Island references.

RANGE. — Endemic to Guadalupe Island.

Intricately and divaricately branched shrub 2–6 dm high, the stems hard and woody, closely cottony tomentose above with very fine dendritic hairs, subglabrescent; internodes to 1 cm; axils mostly with shoots, at least a cluster of leaves and often the stem 3–5 cm long. Leaves spatulate, rounded at apex, mostly 4–6 cm long and 3–10 mm wide above, ± 1 mm wide at base, not decurrent but clearly jointed to stem, thin, at first closely tomen-

tose with dendritic hairs, in age subglabrescent, those below and sometimes well above middle simple and entire, the upper ones lobed at or a little below middle, the lobes spatulate, 1.5–2.5 cm long; higher leaves with lobes more towards base. Bracts ± 2.5 cm long, with pair of ascending lobes near base, the upper with another pair near apex, the lobes spatulate, the middle one 3–5 mm wide, the lateral ± 2 mm wide above. Young spike crowded, 3–6 cm long, with 10–15 or more flowers and buds, the lower internodes after anthesis becoming as much as 13 mm long. Flowers strictly sessile. Calyx tomentose, 21–22 mm long, cleft 4–5 mm before and 9–10 mm behind, the double lateral lobes 3–4 mm wide, retuse to a depth of 0.5–1 mm, the tips rounded. Corolla 19–21 mm long, densely puberulent along the back with multicellular but unbranched non-glandular trichomes 0.1–0.2 mm long, glabrous on the thinner margins, the tip or at least part of the back protruding through posterior sinus of calyx; lip short, the teeth half its length. Stamens shorter than to slightly exceeding corolla, the filaments glabrous, the anthers slender, curved, glabrous, ± 3 mm long. Style exserted 3–5.5 mm, glabrous, thickened and hooked at apex, the stigma papillose. Very immature capsules 7 mm long and 5 mm wide.

Palmer found this plant only in the "middle" of the island, rare among fallen branches (Watson 1876:117). Anthony collected the type specimen (UC 103541) in "an almost inaccessible spot on the western cliff," September 20, 1896. On that date, according to Gaylord (1897:42), Anthony went to the northern limit of the pine, doubtless far out towards North Point. A slip in the pocket reads "only one plant of this species could be reached and that with great difficulty." Drent collected it again in 1898 (UC), and no one has found it since. It may possibly survive on the vast inaccessible northwest cliff; but from Palmer's statement, it probably was not mainly a cliffdweller, so it is very likely extinct.

Galvezia speciosa (Nutt.) A. Gray, Proc. Amer. Acad. Arts Sci. 22:311. 1887.

Gambelia speciosa Nutt., Proc. Acad. Nat. Sci. Philadelphia 4(1):7. 1848.
Antirrhinum speciosum (Nutt.) A. Gray, Proc. Amer. Acad. Arts Sci. 7:376. 1868.

RANGE. — Endemic to Santa Barbara?, Santa Catalina, San Clemente, and Guadalupe Islands. (Not known from the Coronado Islands or the Baja California peninsula, where cited by Wiggins [1980:495])

Shrubs prostrate, or in level protected places to 1.5 m high, or hanging to 3 m from cliffs. Flowers February to August.

Palmer found this shrub frequent in the crevices of high rocks in the "middle" of the island and called it very ornamental, the bright scarlet flowers continuing all summer (Watson 1876:117). It is one of the commoner plants of seacliffs in the northeast part of the island, as well as on shaded cliffs in Oak, Barracks, and Esparsa Canyons. On Islote Negro and Outer Islet it is not confined to cliffs; and probably the same is true of Inner Islet, though there only cliffdwellers can be seen from below.

According to Sutton (1988:511), Guadalupe specimens differ from Californian in the rather broader leaves, with glabrous (not glandular) axils, and in the seeds with less anastomosed winglike ridges on the ventral face. He thought this material might deserve taxonomic recognition.

Gray (1887) combined the North American *Gambelia* Nuttall with the South American *Galvezia* Dombey. Sutton (1988) separated *Gambelia* again on the basis of the thicker-walled capsules with locules opening by several teeth and the bilaterally symmetrical

seeds. However, David Thompson (1993:1032) kept it in *Galvezia*.

Linaria canadensis (L.) Dum.-Cours., Bot. cult. ed. 1, 2:96. 1802.

Linaria canadensis (L.) Dum.-Cours. var. *texensis* (Scheele) Pennell, Proc. Acad. Nat. Sci. Philadelphia 73:502. 1921.

RANGE. — British Columbia to SE USA and southern Baja California and Socorro Island; San Miguel, Santa Rosa, Santa Cruz, Anacapa, Santa Catalina, San Clemente, Los Coronados, Todos Santos, and Cedros Islands.

Palmer found this plant rare on the sides of canyons in the "middle" of the island (Watson 1876:117), and it has seldom been collected since. It grows on grassy slopes of the north ridge at 600–800 m (*M25394*) and in the valley below the Lower Circus at 800 m (*M25389*), in some years very scarce but in wet years locally common.

Mimulus latifolius A. Gray, Proc. Amer. Acad. Arts Sci. 11:95. 1876.

Eunanus latifolius (A. Gray) Greene, Bull. Calif. Acad. Sci. 1:99. 1885.
Mimulus brandegei Pennell, Proc. Acad. Nat. Sci. Philadelphia 99:170. 1947.

RANGE. — Endemic to Guadalupe and Santa Cruz Islands.

Corolla limb pink or lavender-pink; tube dark purplish red; palate ridges yellow with purple spots. Capsule light brown, asymmetric, 16 mm long, flattened contrary to partition, sharply bent 4 mm above base and thence straight; outer cell wider, splitting to bend, the inner apparently not dehiscent. Seeds light brown, smooth and somewhat shining, ovoid, apiculate at both ends, 0.5–0.6 mm long, 0.3–0.4 mm thick.

Palmer found this plant only in the "middle" of the island, scattered in warm rather moist spots (Watson 1876:117). Greene (1885) and Vasey and Rose (1890) listed it without comment. In April 1958 Ernst and I found five plants scattered along the bed of Arroyo Melpomene at ± 450 m (*Moran and Ernst 6738*) (Plate 2K), but I have not seen it there since. In April 1970 it was locally common (*M17392*) with *Polypodium californicum* and *Jepsonia malvifolia* at 800 m on the west-facing gray cliff above West Anchorage and 1 km south of El Picacho. This population, to the windward of upper Arroyo Melpomene, is a likely seed source for the plants found in that arroyo in 1958 and is the only known refuge for the species on the island. On 22 May 1971 I went back, hoping to find seeds, but the few plants seen were less advanced than those of April the year before. This had been a very dry year but with a little rain about two weeks before my visit; possibly the plants had germinated after the rain. The blowing fog of that day perhaps is common, somewhat moistening the upper west slope. It is noteworthy that the polypodium also grows here at its southernmost station on the island and the only place I remember it on any but a northfacing cliff.

Mimulus latifolius belongs to section *Oenoe* A. Gray, including ten Californian species, with capsules woody, asymmetric, tardily or not dehiscent. The type of *M. latifolius* is *Palmer 58* (GH; isotypes MO, NY, PH). From Guadalupe Island, Grant (1924:311) further cited only collections of Bryant in 1885 and Palmer (*839*) of 1889. She also cited a collection of Brandegee in 1888 from Santa Cruz Island: Pennell in 1947 separated that plant as *M. brandegei*, but Thompson (1993) included it again in *M. latifolius*. It is now very rare if not extinct on Santa Cruz Island, where it was last collected by Carl Wolf in 1932 (Junak et al. 1995:264). Another member of *Oenoe*, *M. traskiae* A. L. Grant,

grew on Santa Catalina Island but apparently has not been found since 1903 and possibly is extinct.

Scrophularia villosa Pennell, Field Mus. Bot. Ser. 5:223. 1923.

RANGE. — Endemic to Santa Catalina, San Clemente, and Guadalupe Islands.

Shrub 1–1.5 m high, the woody stem to 8 dm high, to 3 cm thick at base. Flowers in April and May; corolla deep maroon shading to almost black above.

On Guadalupe Island this rare shrub first came to light in 1957, surviving on a few north-facing cliffs in the north and northeast part of the island. All together, I have found only six: four in 1957 at 250 m in Esparsa Canyon (*M5970*); one in 1958 at 120 m in South Esparsa Canyon (*M6596*); and one in 1971 at 675 m near the middle of the north slope of the island (*M18390*). I visited the site in Esparsa Canyon in four later years, and by 1970 all four shrubs apparently were gone. Let us pray.

From the other eight species he recognized for western North America, Shaw (1962) separated *S. villosa* by its shrubby habit, glandular villous inflorescence, and reduced or absent sterile filament. He cited *M5970* from Guadalupe Island.

Solanaceae

Lycium californicum Nutt. in A. Gray, Bot. Calif. 1:542. 1876.

RANGE. — Southern California to Baja California, Arizona, and Sonora; San Miguel, Santa Cruz, Anacapa, San Nicolas, Santa Barbara, Santa Catalina, San Clemente, Los Coronados, Todos Santos, San Martín, San Benito, and Natividad Islands.

Palmer found this shrub on rocky bluffs at the "extreme south end" but not abundant (Watson 1876:117); his specimen was cited by Hitchcock (1932:329). Howell (1942:152) reported it as forming thickets that are one of the characteristic features of the south end, the stems curving to the ground, rooting, and growing up again. Moran (1951:159) found it common on the floor of the crater on Outer Islet (Fig. 34). It is widespread in the southern half of the island, from Long Canyon and West Anchorage to Islote Negro and the south end, especially in the arroyos, from sea level at least to 500 m.

Howell remarked that the flowering parts of his collection were smaller than those described by Hitchcock.

Lycium fremontii A. Gray, Proc. Amer. Acad. Arts Sci. 6:46. 1862.

RANGE. — Southern California to Arizona, southern Baja California, and Sonora; Santa Rosa Island.

This shrub was first found on the island in 1958. So far as known it is very local, on the rocky walls of Arroyo Melpomene at 400 m (*Moran and Ernst 6733*, *M7848*).

†***Nicotiana attenuata*** Torr. in S. Watson, Bot. King Exp. p. 276. 1871.

Nicotiana petuniaeflora Greene, Bull. Calif. Acad. Sci. 1:209. 1885.
Nicotiana bigelovii of Guadalupe Island references.

RANGE. — British Columbia and Montana to Texas and NW Baja California.

"Two or three feet high, stout, viscid-pubescent and somewhat hispid-scabrous: radical leaves oblong-lanceolate, 3–4 inches long on slender petioles; cauline linear-lanceolate, longer than the radical, on shorter petioles; calyx-teeth triangular-lanceolate; corolla an inch and a quarter long, salverform, white changing to bronze-purple; limb three-fourths of an inch broad, with very shallow, scarcely noticeable, rounded or even retuse lobes." (Greene l.c.)

Palmer found this plant (no. 64) in only a few places in the "centre" of the island, in open spots and good soil; flowers greenish yellow, bronzy below (Watson 1876:117). Greene (1885:226) added nothing on the distribution. The last collection was in 1898, by Drent (UC), and the plant undoubtedly is extinct on the island.

Goodspeed (1954:491) listed *N. petuniaeflora* Greene among the insufficiently known species, as "*N. attenuata* Torr.?"; but in treating *N. attenuata* (p. 429), he did not even mention it. Under *N. attenuata*, however, without qualification, he cited *Palmer 64* from Guadalupe Island; and he wrote (p. 47) that the representatives of the species on the island were identical with those on the mainland and thus gave no indication of a long period of isolation. Yet presumably Greene's type collection is of the same species.

****Nicotiana glauca*** Graham, Edinburgh Phil. Jour. 1828:174. 1828.

RANGE. — Native to South America; naturalized from California to Texas and Mexico.

This noxious weedy shrub first reached the island between 1932 and 1948 (Moran 1951:160); by the time of my first visit it was well established in the mouth of the canyon at Northeast Anchorage, where the sharp-eyed Tom Howell had failed to find it 16 years before. It forms thickets there and has spread north and south along the shore and up the slope. Unfortunately, the goats shun it, and it threatens to take the island. Though botanists see the invasion as a disaster, ornithologists Howell and Cade (1954) hailed it as cause for hope, because this large shrub provides extensive cat-resistant habitat for small birds, with nectar for hummingbirds and seeds for passerines.

****Solanum americanum*** Mill., Gard. Dict., ed. 8. 1768.

Solanum nodiflorum Jacq., Ic. Pl. Rar. 2:288. 1786–93.
Solanum calvum Bitter, Repert. Sp. Nov. 12:81. 1913.
Solanum nigrum of Guadalupe Island references

RANGE. — Apparently native to tropical America; a widespread weed in North America and elsewhere.

Palmer found this plant rare in the "middle" of the island and in a canyon near the beach on the east side, in rich level spots (Watson 1876:117); and on his second trip he found a single plant in a canyon at the south end (Vasey and Rose 1890:26). Franceschi (1893c:137) found it more common, a few in crevices of the Lower Circus and more in the canyon near the landing. I have not seen it in the northern half of the island, but it grows sparingly farther south, as at the lobster camp and near the mouth of Arroyo Melpomene.

Bitter based *S. calvum* on *Palmer 60 pro parte* (UPS). He described the specimen in great detail but did not compare it with any other species. It appears not to differ from *S. americanum*. Dr. G. L. Stebbins in 1958 verified my identification of one collection (*M6448*) with *S. nodiflorum*.

Solanum douglasii Dunal in A. DC., Prod. 131:48. 1852.

Solanum nigrum L. var. *douglasii* (Dunal) A. Gray, Syn. Fl. N. Amer. ed. 2, 21:228. 1886.
Solanum profundeincisum Bitter, Repert. Sp. Nov. 12:80. 1913.

RANGE. Central California to Southern Baja California and central Mexico; San Miguel, Santa Rosa, Santa Cruz, Anacapa, San Nicolas, Santa Barbara, Santa Catalina, and San Clemente Islands.

Palmer found only two plants, in a canyon near the beach on the east side (Watson 1876:117). Greene (1885:226) also saw two plants in the canyon near the beach, "perhaps the very same individuals seen by Dr. Palmer." Franceschi (1893c:137) found three plants, two on the lava dike at the southern side of the landing and one a little way up the canyon. There are no other reports. The plant is now rare on the island, seen only in the northeast part. In 1957 two grew on a south-facing cliff at 450 m on the north rim of Barracks Canyon at the mouth (*M6116*), but by 1960 one of these was gone. In 1958 several grew on a south-facing talus slope at 200m in South Esparsa Canyon (*M6602*).

Bitter based *S. profundeincisum* on *Palmer 60 pro parte* and *61* (UPS). Again, although he described the specimens in great detail, he did not compare his proposed species with *S. douglasii* or with any other species. I do not see that it differs at all.

Solanum wallacei (A. Gray) Parish ssp. ***clokeyi*** (Munz) Thorne, Aliso 7:76. 1979.

Solanum arborescens Clokey, Bull. S. Calif. Acad. Sci. 30:60. 1931. Not Moench.
Solanum clokeyi Munz, Bull. S. Calif. Acad. Sci. 31:69. 1932.
Solanuim wallacei var. *clokeyi* (Munz) McMinn, Ill. Man. Calif. Shrubs p. 491. 1939.
Solanum wallacei, *S. xanti*, and *S. xanti* var. *wallacei* of Guadalupe references.

RANGE. — Endemic to Santa Rosa, Santa Cruz, and Guadalupe Islands.

Weak shrub to 16 dm high, the stems brittle, 1 cm thick, to 5 cm at common base. Herbage viscid, densely soft white pubescent, at first very densely so and yellowish, the trichomes spreading, mostly unbranched, of unequal lengths intermixed, 0.2–1 (–2) mm long, uniseriate, of 2–15 cells tipped with a tiny yellowish globule. Leaf blades ovate to oblong-ovate, acute or subacute, cordate to subtruncate at base, entire or faintly and irregularly crenate, 3–6 cm long, 15–37 mm wide; petioles 6–12 mm long. Cymes on peduncles 10–23 mm long, of mostly 2 cincinni of 7–9 flowers each, the axes at length to 23 mm, the pedicels slender, pubescent, 10–21 mm long. Flowers Jan.–May, at times abundant and showy. Calyx pubescent, in flower campanulate, 3–4 mm long, in fruit shallowly bowl-shaped, 12 mm wide, the lobes deltoid-ovate, acute or becoming rounded, 1.5–2 mm long. Corolla rotate, shallowly 5-lobed, 2–3 cm wide, blue-violet, pubescent outside on parts exposed in bud, with paired green spots surrounded by white inside at base opposite each lobe, the lobes broadly ovate, acute, 7–9 mm long and wide. Filaments adnate 2 mm to corolla base, equal, 4 mm long and 1 mm wide at base, puberulent; anthers equal, yellow, 3.5–4 mm long, 1.5 mm wide, splitting lengthwise. Ovary globular, green, 1.5–2 mm thick; style 8–10 mm long, papillose in lower third and with a few scattered short trichomes, glabrous above. Old fruit 1 cm thick, orange-brown, glabrous and somewhat shiny. Seeds red-brown, obliquely ovate, 1.9–2.1 mm long, 1.4–1.6 mm wide, 0.6–0.8 mm thick, the margins rounded, the surface closely pitted with round-bottomed pits 0.02–0.1 mm wide. Chromosomes: $n = 12$ fide Marion Cave.

Palmer found this plant only in the "middle" of the island, in the crevices of rocks (Watson 1876:117). He called it a very showy shrub, in large bunches about two feet high, blooming

all year; flowers numerous, lilac or purple. Greene (1885:226) found it common on the plateau, in round compact masses three feet or more in height and thickness. Franceschi (1893c:137) found it on the eastern cliff a little south of the corral, already in flower at the beginning of January. I have found it (*M7837* etc.) only on the cliff of the Lower Circus, the place meant by Franceschi and perhaps also by Palmer. Here I saw mainly one colony of about ten plants, very showy and conspicuous in flower, surviving fortuitously high on the cliff in a pocket of rich soil like a window box, suitable for continued reproduction yet beyond the reach of goats. I saw only one old fruit, from the year before. In 1988 I saw another plant out of reach farther north on the cliffs.

Palmer described the fruit as small, changing from green to yellow, mottled, and at length very dark plum color, maturing very slowly. Both Katherine Brandegee (in Franceschi 1893c:137) and Greene identified the Guadalupe Island plants with *S. xanti* var. *wallacei* of Santa Catalina Island, though Gray (Watson 1876:117) had referred Palmer's collection to *S. xanti* and not to the variety. The ssp. *clokeyi* is a smaller shrub than ssp. *wallacei*, with shorter, less dense, and less tawny pubescence, smaller leaves, smaller flowers, and smaller fruit. It needs closer comparison with the variable *S. xanti* of the mainland.

Umbelliferae

Daucus pusillus Michx, Fl. Bor. Amer. 1:164. 1803.

RANGE. — Vancouver Island to central Baja California, SE USA, and South America; islands of southern California and Los Coronados and Todos Santos.

Palmer found this plant abundant through the "middle" of the island, among sage brush on the sides of canyons and in open level places (Watson 1876:115). Greene 1885:223) noted it without comment. It now seems to be rare, known from only one collection this century: scarce on grassy slope at 900 m south of the cypress grove (*M6676*).

Lomatium insulare (Eastw.) Munz, Man. S. Calif. Bot. 358. 1935.

RANGE. — Endemic to San Nicolas, San Clemente, and Guadalupe Islands.

Moran (1951:159) found this plant on the inner slope of the crater of Outer Islet and also near the southwest corner of the south-end mesa. On Outer Islet it grows not only in the crater but also in the upper valley at 190 m, where one plant measured 7 dm wide. On the mesa it seemed at first very local in a shallow arroyo at 100 m, just above Campo Sur (Fig. 77), and so far as I have seen has since spread less than 1 km to the north. Plants seen on the mesa in June and August were completely dormant and were dead above ground.

This plant also grows at 500 to 800 m on foggy northwest cliffs from North Point to Hemizonia Cliff, flowering December to May (*M6437, M13813, M17298*). Leaf segments are wider here than in plants at the south end.

Urticaceae

†***Hesperocnide tenella*** Torr., Pacif. Railr. Rept. 4:139. 1857.

RANGE. — Central California to NW Baja California; Santa Cruz, Santa Barbara, Santa Catalina, San Clemente, Los Coronados, Todos Santos, and San Martin Islands.

FIGURE 77. The insular endemic *Lomatium insulare* (*M12069*) on the south-end mesa, 5 March 1965. It grows also on Outer Islet and on cliffs at the north end, and on San Clemente and San Nicolas Islands.

Palmer found this plant in damp shady places, among high rocks, in the "middle" of the island (Watson 1876:119). Greene (1885:227) listed it without comment, and Franceschi (1893c:137) found it very common everywhere. Apparently no one has seen it since, and evidently it is extinct on the island.

Parietaria hespera B. D. Hinton var. ***hespera***.

Parietaria hespera B. D. Hinton, Sida 3:293. 1969.
Parietaria debilis and *P. floridana* of Guadalupe Island references.

RANGE. — Central California to Utah, New Mexico, and NW Mexico; islands of southern California and south to Cedros.

Palmer found this plant abundant in damp shady places (Watson 1876:119). It is rather common among rocks from shore to summit and from the north slope to the south end mesa and on Islote Negro and Outer Islet.

Viscaceae

†***Phoradendron densum*** Trel., Gen. Phorad. p. 27. 1916.

Phoradendron guadalupense Trel., Gen. Phorad. p. 29. 1916.
Phoradendron bolleanum (Seem.) Eichler ssp. *densum* (Trel.) Wiens, Brittonia 16:29. 1964.
Phoradendron bolleanum and var. *pauciflorum* of Guadalupe Island references.

RANGE. — Oregon to Baja California and Chihuahua.

Palmer found this mistletoe near the "south end", on *Cupressus* and more frequently on *Juniperus* (Watson 1876:119). Bryant (1887:295) mentioned mistletoe on the cypress at a height of 20 feet. However, Greene did not see it in 1885, and apparently no one has found it since. I have examined most of the remaining junipers and could scarcely have missed the mistletoe had it been there. I have also looked for it several times on some hundreds of cypress trees and, strange to say, have failed to find it — though there I am less certain it is absent. If it was originally rare on the cypress, could it have required the large seed source on the junipers to ensure infection of the less susceptible cypress? Or is it still there after all?

Fosberg (1941) doubtfully referred *P. guadalupense* to *P. bollenanum* var. *pauciflorum* (Torr.) Fosberg, saying there was not enough material to decide its status. Wiens (1964:29) wrote that the Guadalupe plant did not differ in any important way from *P. bolleanum* ssp. *densum*.

Familia ignota

†***Planta*** species

Sanicula menziesii? of Guadalupe Island references.

RANGE. — Presumably endemic to Guadalupe Island.

In the crevices of rocks in the "middle" of the island Palmer found two plants only, without flowers or fruit, of what Watson (1876:115) doubtfully identified as *Sanicula menziesii* Hook. & Arn. No one has since found anything like it, and presumably it is extinct. Dr. Lincoln Constance examined the specimen and concluded it was not *Sanicula* or any other Umbellifer. Since he and Dr. P. A. Munz and other botanists well-versed in the flora of California failed to recognize even the family of this specimen, I assume that it was at least an endemic species and so list it with the endemics.

The specimen at GH could not be found recently. The only trace of it is a faded and blurred copy of a memo from Dr. Munz to Peter Raven (SD), with a sketch of one of the three leaves. These were "palmately about 5-lobed, with very laciniate and irregular margins, prominent venation, and distended petiole bases (like an umbellifer). If I were going to check on it, I'd think Umbelliferae or maybe Jatropha."

MONOCOTS

Gramineae

Aristida adscensionis L., Sp. Pl. p. 82. 1753.

Aristida bromoides HBK, Nov. Gen. Sp. 1:122. 1815.

RANGE. — California and Texas to Argentina; Santa Rosa, Santa Cruz, Santa Catalina, San Clemente, and Cedros Islands.

Palmer found this grass in deep canyons among other grasses and plants (Vasey and Rose 1890:27). Hitchcock (1924:544) cited his collections and one by Rose (*16951*). It is widespread at low elevations on the island but not common.

**Avena barbata* Pott ex Link, Schrad. Jour. Bot. 2:315. 1799.

RANGE. — Native to Europe; now a widespread weed.

On his second trip Palmer found this grass in canyons and on rough slopes (Vasey and Rose 1890:27). It is now widespread on the island and in some places fairly common. It is the only member of the genus collected in recent years.

†**Avena fatua* L., Sp. Pl. p. 79. 1753.

RANGE. — Native to Europe; now a widespread weed.

Palmer found several patches in open places and on the best soil (Watson 1876:120). Greene (1885:228) saw very little and remarked that apparently it was not established. It has not been found recently. Gould and Moran (1981:40) tentatively identified *Palmer 94a* (MO) with *A. fatua* though it has some characters of *A. barbata*.

†**Avena sativa* L., Sp. Pl. p. 79. 1753.

RANGE. — Native to Europe; widely grown as a crop plant and sometimes escaping.

Gould and Moran (1981:40) identified *Palmer 94* (MO) as an atypical form of this species. Apparently it has not been collected since.

**Bromus berteroanus* Colla, Mem. Acc. Turin 39:25. 1835.

Bromus trinii Desv. in Gay, Fl. Chil. 6:441. 1853.
Trisetum barbatum Steudel, Syn. Pl. Glum. 1:229. 1854.
Bromus sterilis of some Guadalupe Island references.

RANGE. — Native to southern South America; a weed in SW USA and NW Mexico.

On his second trip, in a year of frequent rains, Palmer found this grass abundant and often large at the south end and very common also in the northern part of the island (Vasey and Rose 1890:26, 27). He added that it made the best forage at the north end, in the canyons very large and growing so thickly that it looked like grain. It is now widespread at low elevations but generally scarce. I have never seen it common.

**Bromus diandrus* Roth, Bot. Abh. p. 44. 1787.

Bromus maximus Desf., Fl. Atlant. 1:95. 1798.
Bromus rigidus of Guadalupe Island references.
Bromus sterilis of some Guadalupe Island references.

RANGE. — Native to Europe; a weed in SW USA and NW Baja California.

Greene (1885:228) reported this grass as abundant, saying that not even the goats were fond of it. It is now widespread on the island, from the north end to Arroyo Melpomene, sometimes locally common.

**Bromus hordeaceus* L., Sp. Pl. p. 77. 1753.

Bromus mollis L., Sp. Pl. ed. 2, 1:112. 1762.

RANGE. — Native to Europe; a widespread weed.

Moran (1951:159) found this grass occasional in the canyon mouth at Northeast Anchorage in 1948. It has since spread up the northeast side of the island to the area of the springs.

Bromus rubens L., Cent. Pl. 1:5. 1755.

Bromus madritensis ssp. *rubens* (L.) Husnot, Gram. Fr. Belg. p. 71. 1899.

RANGE. — Native to Europe; a widespread weed.

Howell (1942:146) collected this grass at Northeast Anchorage and reported it not common. It has now spread upward to the pine ridge and Oak Canyon and south to Long Canyon and in many places is rather common.

†***Bromus tectorum*** L., Sp. Pl. p. 77. 1753.

Bromus sterilis of some Guadalupe Island references.

RANGE. — Native to Europe; a frequent weed through much of the USA and in NW Mexico.

Wallace (1985:87, 98) reported *B. tectorum* for Guadalupe Island, based on *Palmer 99* (NY) in part. Watson (1876:120) had listed this collection as *B. sterilis* L., with Palmer's comment that it was on warm hillsides, sometimes in large patches as if sown, at the "south end" and "middle"; but according to Wallace it is a mixture of *B. tectorum* and *B. trinii* [= *B. berteroanus*]. Presumably it was *B. berteroanus* that was so abundant, for *B. tectorum* has not otherwise been reported from the island and probably never became well established.

†***Dissanthelium californicum*** (Nutt.) Benth., in Hook.f., Icon. Pl. 14:56, pl. 1375. 1881.

Stenochloa californica Nutt., Jour. Acad. Nat. Sci. Philadelphia, Ser. 2, 1:189. 1848.

RANGE. — Endemic to Santa Catalina, San Clemente, and Guadalupe Islands.

Palmer found this grass on warm rocky slopes in the "middle" of the island but not very abundant (Watson 1876:120). He said it was very succulent and that the goats were very fond of it. No one has found it since. Likewise, it has been found only once on Catalina and once on San Clemente: evidently, it is extinct.

Hordeum murinum L. ssp. ***glaucum*** (Steud.) Tzvelev, Novosti Sist. Vyssh. Rast. 8:67. 1971.

Hordeum glaucum Steud., Syn. Pl. Glum. 1:352. 1855.
Hordeum stebbinsii Covas, Madroño 10:17. 1949.

RANGE. — Native to Europe; a widespread weed.

Greene (1885:228) reported "only a few tufts" of *H. murinum* [ssp. *glaucum*?] near the cabins on the plateau, "but the seed is there and it will hardly fail to become abundant." The ssp. *glaucum* is now widespread on the island and certainly one of the most abundant plants.

Hordeum murinum L. ssp. ***leporinum*** (Link) Arcang., Comp. Fl. Ital. p. 805. 1882.

Hordeum leporinum Link, Linnaea 9:133. 1835.

RANGE. — Native to Europe; a widespread weed.

The ssp. *leporinum* is also widespread on the island but is less abundant.

Lamarckia aurea Moench, Meth. Pl. p. 201. 1794.

RANGE. — Native to southern Europe; a common weed from California to Texas and northern Mexico.

Meling López (1985) was first to find this weed on the island (Zona Bosque, *Meling López 041*, SD). In 1988 it was occasional near the spring and above (*M31009*).

Melica imperfecta Trin., Mem. Acad. Imp. Sci. St.-Petersbourg, Ser. 6, Sci. Math. 2:59. 1836.

RANGE. — Central California to central Baja California; islands of southern California and south to Cedros.

Palmer found this grass in crevices of high rocks in the "middle" of the island (Watson 1876:120). Greene (1885:228) found only one tuft in a place inaccessible to goats. It is now rare, on cliffs in the northeast part of the island, seen in 1967 on the Lower Circus at 950 m (*M13783*) and in Southeast Oak Canyon at 400 m (*M13791*).

Muhlenbergia microsperma (DC.) Kunth, Rev. Gram. 1:64. 1829.

Muhlenbergia debilis (HBK) Kunth, Rev. Gram. 1:63. 1829.

RANGE. — SW USA to Peru; islands of southern California except San Nicolas and of NW Baja California south to Cedros.

Palmer found this grass abundant on warm slopes in the "middle" of the island and less common at the "south end" (Watson 1876:120). Palmer's collections of 1889 were cited by Hitchcock (1913:294). It is now widespread on the island, from the pine ridge to the south end mesa, but not very common.

Phalaris caroliniana Walter, Fl. Carol. p. 74. 1788.

Phalaris intermedia Bosc ex Poir., Encycl. Suppl. 1:300. 1810.

RANGE. — Southern USA and northern Mexico; Santa Cruz, San Nicolas, Santa Barbara, Santa Catalina, and San Clemente Islands.

Brandegee (1900) first reported this grass from Guadalupe Island, but without specific locality. It appears to be local on the island and rather uncommon, in arroyos below 500 m west to northwest of the lobster camp. This little visited part of the island is where *Cistanthe maritima*, *Gnaphalium bicolor*, *Stipa lepida*, and *Stebbinsoseris heterocarpa* also appear to be local.

Most authors treat this grass as introduced in western North America, often saying it grows in disturbed places; and there is no clear way to tell. However, its distribution on the island and in wild parts of northern Baja California suggests to me that it may be

native. Also, Raven (1963:315) quoted Dennis E. Anderson as feeling then that it might well be native in California, even though later Anderson (1993:1282) has treated it as introduced.

****Phalaris minor*** Retz., Obs. Bot. 3:8. 1783.

RANGE. — Native to the Mediterranean region; a widespread weed in North and South America.

This grass was first found on Guadalupe Island in 1958, scarce at Northeast Anchorage (*M6789, Wiggins & Ernst 216*). It persists in that area and also grows in an arroyo bed near the southwest corner of the island (*M31015*).

****Poa annua*** L., Sp. Pl. p. 68. 1753.

RANGE. — Native to Europe but now widespread in North America.

Howell (1942:147) found this grass in the pine grove. It is now abundant on the upper north slope and about the spring and is scattered elsewhere in the northern part of the island.

Poa secunda J. Presl ssp. ***secunda***

Poa secunda J. Presl, Reliq. Haenk. 1:271. 1825–30.
Poa scabrella (Thurb.) Vasey, Grasses U. S. p. 42. 1883.

RANGE. — Alaska to northern Baja California; San Miguel, Santa Rosa, Santa Cruz, Anacapa, San Nicolas, Santa Catalina, San Clemente, and Todos Santos Islands.

This grass is known on Guadalupe Island from one collection: one clump on face of Hemizonia cliff at 800 m, 3 May 1967 (*M13816*).

****Polypogon monspeliensis*** (L.) Desf., Fl. Atlant. 1:67. 1798.

RANGE. — Native to Europe; a widespread weed in North America.

Greene (1885:228) found this grass common about the springs. It is still common there and occurs more sparingly under pines at the north end and in the streambeds of the canyons draining the northeast part of the island and south to Juniper Canyon.

Stipa lepida A. S. Hitchc., Amer. Jour. Bot. 2:302. 1915.

Nasella lepida (A. S. Hitchc.) Barkworth, Taxon 39:610. 1991.

RANGE. — Northern California to southern Baja California; islands of southern California and Los Coronados and Cedros.

This grass was first found on Guadalupe Island in 1958. It appears to be local on the east side south of the middle of the island: east slope of El Picacho, 450 m (*M6754, Wiggins & Ernst 199*); west of the lobster camp, 70 m (*Wiggins & Ernst 203*).

****Triticum aestivum*** L., Sp. Pl. p. 85. 1753.

RANGE. — Native to Eurasia; widely cultivated and occasionally escaping but unlikely to persist out of cultivation.

Meling López (1985) was first to find this grass on the island (Corrales, zona bosque, *Meling-López 042*, SD), and there seems to be no later record.

†****Vulpia bromoides*** (L.) Gray, Nat. Arr. Brit. Pl. 2:124. 1821.

RANGE. — Native to Europe; widespread in North America.

"Guadaloupe Islands," April 1889, *Dr. E. Palmer 674* (POM/RSA), as checked by Tim Ross and as noted by Wallace (1985:33, 90). According to McVaugh (1956), this would be from the northeast part of the island. I have seen no other record.

Vulpia microstachys (Nutt.) Benth. var. ***pauciflora*** (Beal) Lonard & Gould, Madroño 22:226. 1974.

Festuca pacifica Piper, Contr. U. S. Natl. Herb. 10:12. 1906.

RANGE. — British Columbia to southern Baja California; San Miguel, Santa Cruz, Anacapa, Santa Catalina, San Clemente, San Martín, and Cedros Islands.

Palmer found this grass in bunches on warm slopes and in open places in the "middle" of the island (Watson 1876:120), and Greene (1885:228) listed it without comment. This century it seems to have been found only rather scarce near the springs and old ranch (*Moran 6658*, *Wiggins & Ernst 114*).

****Vulpia myuros*** (L.) C. C. Gmelin var. ***hirsuta*** Hack., Cat. Gramin. Portugal, p. 24. 1880.

Festuca megalura Nutt., Jour. Acad. Nat. Sci. Philadelphia Ser. 2, 1:188. 1848.

RANGE. — British Columbia and Montana to southern Baja California; islands of southern California and Todos Santos; native to Europe.

On his second trip Palmer found this grass in canyons, not common (Vasey and Rose 1890:27). It is now very common in the northern part of the island, from sea level to the top of Mt. Augusta.

Vulpia octoflora (Walter) Rydb. var. ***hirtella*** (Piper) Henrard, Blumea 2:320. 1937.

Festuca octoflora Walter var. *hirtella* Piper, Contr. U. S. Natl. Herb. 10:12. 1906.
Festuca tenella of Guadalupe Island references.

RANGE. — British Columbia to Texas and central Baja California; islands of southern California and Todos Santos, San Martín, and Cedros.

On his second trip Palmer found this grass in the southern part of the island (Vasey & Rose 1890:26); his collections were cited by Hitchcock (1913:378) as *F. octoflora* var. *hirtella*. Howell (1942:146) found it not common in the middle part of the island. It appears to be rather local at widely separated places on the island: South Esparsa Canyon, 50 m (*M6595*); south flank of El Picacho, 650 m (*M6741*); Melpomene drainage, 300 m (*M6729A*). On the flank of El Picacho it was abundant over a gently sloping area several hundred meters wide.

Juncaceae

Juncus bufonius L., Sp. Pl. p. 328. 1753.

RANGE. — Widespread on all continents; San Miguel, Santa Rosa, Santa Cruz, Anacapa, San Nicolas, Santa Catalina, and San Clemente Islands.

Palmer found this rush from the "middle" to the north end of the island, abundant in springy places (Watson 1876:120). It is still common locally in seasonally wet places throughout the island, from the spring to tinajas in Arroyo Melpomene.

Liliaceae

ϕ***Dichelostemma pulchellum*** (Salisb.) A. Heller, Muhlenbergia 1:132. 1906.

Brodiaea capitata Benth., Pl. Hartw. p. 339. 1857.
Brodiaea insularis Greene, Bull. Calif. Acad. Sci. 2:134. 1886.
Dichelostemma insulare (Greene) Burnham, Muhlenbergia 3:74. 1907.
Dipterostemon insulare (Greene) Rydb., Bull Torrey Bot. Club 39:111. 1912.
Brodiaea capitata Benth. var. *insularis* (Greene) J. F. Macbr., Contr. Gray Herb. 56:9. 1918.

RANGE. — Southern Oregon to central Baja California; islands of southern California and south to San Benitos and Cedros.

Greene (1885:216) reported this plant exceedingly common on the tableland about the spring and on the declivity below. On his second visit, Palmer found it quite plentiful in deep ravines and on hillsides at the south end (Vasey and Rose 1890:26). It is widespread on the island, from the north slope to Outer Islet. In the northern part it seldom reaches flowering size except on cliffs. Farther south, beyond the range of most goats, it is fairly common in some places and often does flower.

Brodiaea insularis, of the islands from San Miguel to Guadalupe, Greene (1886) separated mainly on the basis of its larger size: "Closely allied to [*B. capitata*] but many times larger. . . . Scape 3–5 feet high: leaves often a yard long and an inch broad: . . . corms . . . the largest in the genus, often two inches in diameter. . . ." However, the island plants are by no means always large, and Hoover (1940:471) wrote that in favorable situations and in favorable seasons plants of the mainland may grow as large as any seen from the islands. Although he supposed that their often larger size probably had some genetic basis, he did not separate the island plants taxonomically — nor have others. In fact, the Guadalupe plant may not belong with the other island plants genetically.

Greene said he could not account for Palmer's failure to either collect this plant or make note of its presence on the island. This was remarkable considering that Palmer had camped for 15 weeks where Greene now found it so common and, in fact, where he collected three other plants Palmer had not found. The only explanation seems to be that it was a late arrival not yet established on the island. I therefore list it as a probable newcomer (Table 2).

Triteleia guadalupensis L. W. Lenz, Aliso 7:145, figs. 1, 2. 1970.

Brodiaea lugens and *Triteleia lugens* of Guadalupe Island references.

RANGE. — Endemic to Guadalupe Island.

Corms 2–3.5 cm thick, the thick coat of coarse fibers extending upward to form a neck. Leaves two, 3–11.5 dm long, 12–32 mm wide. Scapes 3–7.4 dm tall, 2–5 mm thick, smooth or slightly scabrous; involucral bracts ovate, acuminate, 1–5 cm long. Flowers (Plate 2L) in March to May, about 20–30, on pedicels 1.5–5 cm long. Perianth golden yellow, 27–32 mm wide, 14–21 mm long (closed), the tube funnelform, 5–9 mm long, the segments widespreading, 12–14 mm long, 4–8 mm wide, papillose at apex, each with green to dark purple midvein, the outer ovate, narrowly rounded at apex, the inner elliptic, broadly rounded and emarginate at apex. Filaments all inserted at mouth of perianth tube, alternately long and short, oblong or subcuneate, subtruncate and mucronate at apex, the mucro bearing the anther, the longer 5–6 mm long, 3 mm wide, the shorter 2–3 mm long; anthers pale yellow, 2–3 mm long. Ovary twice as long as stipe. Chromosomes: $n = 8$. (Description broadened from Lenz 1970).

Brandegee (1900:22) found this plant common along the slopes of Sparmanns Canyon (perhaps Esparsa Canyon?), and Moran (1951:160) found it high at the north end. It grows on shaded cliffs in the northern two-thirds of the island, in some places rather common locally: Hemizonia Cliff, 800 m (*M13811* etc.); Oak Canyon 850 m (*M12301*); Esparsa Canyon 250 m (*M5969*); head of canyon west of the lobster camp (*Weber & McCoy 12016*) [near the following]; east slope of El Picacho, 350 m (*M12063*, type collection).

In a careful revision of *Triteleia*, Hoover (1941) placed Brandegee's specimen under *T. lugens* Greene, a rare species which, in his sense, had a remarkable disjunct distribution in the inner North Coast Ranges of California, the San Gabriel Mountains, and Guadalupe Island. On the basis of living plants, Lenz (1970) separated *T. guadalupensis*, with *Moran 12063* (SD59967) as holotype; and he concluded that the plant of the San Gabriel Mountains also was specifically distinct. Thus he restricted typical *T. lugens* to central California, where it is now known from Monterey and San Benito Counties as well as the North Coast Ranges. He distinguished *T. guadalupensis* from *T. lugens* by its generally larger size, its larger corms whose thick coat of coarse fibers extends above the top to form a distinct neck, and its golden yellow perianth with a longer and broader tube. He said that in flower color and shape it approached the plants of Monterey and San Benito Counties more closely than it did the more northern ones. From field-collected buds of the type collection, Dr. Marion Cave got a meiotic chromosome count of $n = 8$.

Palmae

Brahea edulis H. Wendl. in S. Watson, Proc. Amer. Acad. Arts Sci. 11:146. 1876.

Erythea edulis (H. Wendl.) S. Watson, Bot. Calif. 2:212. 1880.

RANGE. — Endemic to Guadalupe Island.

This is a palm to 10 m tall, with a clean columnar trunk 2–4 dm thick above the enlarged base, with green costapalmate leaves 2–3.5 m long (Fig. 78), and with a finally pendent inflorescence 1–3 m long bearing edible black drupes 2.5–3.5 cm thick (Fig. 79).

Palmer reported the palm as frequent in deep warm ravines, from the northern end to Jacks Bay [West Anchorage] (Watson 1876:120). Franceschi (1893a) wrote that the only considerable remaining grove was on the northwest slope, covering an area not less than one mile and a half long, and one-half to one mile wide, though formerly extending farther north as shown by burned trunks. He said that palms used to grow in the canyon coming down to the landing [Barracks Canyon], "where man has destroyed them all for thatching the cabins with their leaves and eating the central Cabbage, which is indeed

FIGURE 78. The endemic Guadalupe Island palm (*Brahea edulis*) on the north slope of the island, 13 April 1970. This handsome palm in commonly grown in southern California and elsewhere.

delicate and sweet." And he told of what appeared to be the scattered remains of a formerly considerable grove on the two sides of Esparsa Canyon. Dudley (1899:283) reported 50 or more palms in each of three canyons opening into the central valley [Arroyo Melpomene] above the south anchorage. Brown mentioned a small grove on the west side near Steamer Point (Thayer and Bangs 1908:102). Hanna (1925:237, pl. 19, fig. 2) reported about a thousand palms remaining in Esparsa Canyon.

Much of the fine grove described by Franceschi still stands on the northwest slope (Fig. 24), extending about 3 km in a northeast-southwest direction and from the top of the seacliffs at about 450 m up to 800 m and having probably several thousand trees. A few grow among the pines to the northeast (Fig. 20). No palms remain in Barracks Canyon, as Franceschi said, though a few old palm roots were still to be seen in 1960. Several hundred palms remained in Esparsa Canyon in 1970, at about 250 to 400 m, but scarcely the thousand seen by Hanna 50 years before. Palms remain in three other shallower canyons on the east side, south as far as El Picacho. In the one emptying at the lobster camp I counted 69 palms in 1957, at 250 to 450 m. On the west side there are still palms in the canyon above West Anchorage; and in 1957 about 30 grew in a hanging valley at 350 m some 7 km south of El Picacho (Lindsay 1966:8, photo). I saw none in the tributaries of Arroyo Melpomene.

All these palm groves are of old trees: no seedling escapes the goats. I have seen only two palm seedlings on the island. One was in Arroyo Melpomene, but it has since disappeared. Possibly this was from a seed dropped by someone carrying a palm inflorescence to the village to feed a domestic goat once kept there. The other was in the arroyo not

FIGURE 79. Fruit of the endemic Guadalupe Island palm (*Brahea edulis*)(*M12066*) on the north slope of the island, 4 March 1965. Palmer remarked that the fruit was eaten by man, goats, birds, and mice.

far above the lobster camp, where it was not likely to survive the goats for long.

Palmer said that the clusters of fruit (Fig. 79) weighed 40 or 50 pounds and that the fruit was eaten by man, goats, birds, and mice. Franceschi wrote that the fruits were similar in size and taste to prunes, and he evidently considered them an additional dividend to be got from growing an excellent palm. At just the right stage between greenness and decay, the fruits are indeed quite edible; but to me they are less like prunes than like some inferior kind of date.

Bailey (1937) had six species of *Erythea*, native in northwest Mexico; Uhl and Dransfield (1987) recognized about 16 species of *Brahea*, including *Erythea*, native to Mexico and Guatemala, though saying that a new taxonomic treatment was much needed. The nearest species geographically is *B. armata*, of northern and central Baja California. An interesting question is how the original palm seed got to the island (Moran 1978). The fruits and

seeds of *B. edulis* are too dense to float in sea water, and it would take an enterprising bird to carry so heavy an object so long a distance. The inflorescence might float; but it is most unlikely either to become detached or to be carried down a turbulent rain-swollen arroyo to the sea while still bearing fruit.

Guadalupe Island palm is well established in cultivation in southern California and elsewhere and makes a very handsome tree. Its merits greatly impressed Dr. F. Franceschi, a noted horticulturist, later of Santa Barbara but in 1892 newly arrived in California (cf. Tucker 1945); and in the winter of 1892–93 he visited Guadalupe Island largely to gather fuller information about it. Writing later about the palm in its island home and in cultivation, Franceschi (1893a) noted that fresh seed germinate in a few weeks, though older ones take several months; and that afterwards this palm grows nearly as quickly as *Washingtonia filifera* and *Phoenix canariensis*, two well-known fast growers. And he wrote that horticulturists "are sure to find it to be the most elegant of all Fan Palms from the North American continent."

Zosteraceae

Phyllospadix torreyi S. Watson, Proc. Amer. Acad. Arts Sci. 14:303. 1879.

RANGE. — Oregon to central Baja California; islands of southern California.

Dudley (1899:283) reported this surf-grass as scarce, near the west and south anchorages. It is common enough on the intertidal reef at West Anchorage and off the landing at Campo Sur. Also, it was collected for me by diver Wes Andrew at the south end and by him and by divers Jim Stewart and Jay Quast at Northeast Anchorage.

Zostera marina L., Sp. Pl. p. 968. 1753.

RANGE. — Alaska to Baja California and Atlantic coast; Santa Rosa, Santa Cruz, Anacapa, Santa Catalina, Los Coronados, San Martin, San Gerónimo, and Cedros Islands.

This eel-grass was collected for me in January 1960 by divers Jim Stewart and Jay Quast at 140 feet at Northeast Anchorage (*M7844*). Anne Mower annotated the sterile specimen in 1969, saying it looked like the shallow-water form.

DOUBTFUL AND EXCLUDED SPECIES

Chamaesyce melanadenia (Torr.) Millsp., Field Mus. Nat. Hist. Bot. Ser. 2:410. 1916.

Euphorbia melanadenia Torr., Pacif. Railr. Rept. 4:135. 1857.

Wheeler (1934, 1936:439) reported this species from Guadalupe Island on the basis of specimens (F, GH) collected by Palmer in 1889. On two specimens the labels — one handwritten, the other typed — say "Lagoon Head" but not "Guadalupe Island." A third label has printed on it "Lagoon Head" and "March 9, 1889"; but "Guadalupe Island, Lower Calif." is written below. The field number (*783*) falls in the series for Lagoon Head and inland rather than in that for Guadalupe Island (McVaugh 1956:239, 230), and the date agrees. Furthermore, Vasey and Rose (1890:12) cited this collection as from hills 40 miles back from the ocean, Lagoon Head, Baja California, showing they had fuller information than appeared on these labels. Thus the report for Guadalupe Island seems clearly mistaken.

Pachycereus pringlei (S. Watson) Britton & Rose, Contr. U. S. Natl. Herb. 12:422. 1909.

When in a letter to Spencer Baird, Xántus improvised *Cereus giganteus* on Guadalupe Island, Zwinger (1986:88, note 13) wrote: "*Cereus giganteus*, Saguaro, does not reach this far west and south; what Xántus saw was *Pachycereus pringlei*, Cardón, a then-uncollected species." It is still uncollected, however, and there is no reason to believe that Xántus saw *any* giant cactus on the island; see under Xántus, p. 45.

Solanum tenuilobatum Parish, Proc. Calif. Acad. Sci. Ser. 3, 2:165. 1901.

A specimen of this species (SD119427) is labeled as from Guadalupe Island: Arroyo, Zona Sur, 3 km N Morro Sur, Alf Enrique Meling L., 30 March 1982. This rare plant is otherwise known from a few places in chaparral at 200–1100 m in southwestern San Diego County, California (Beauchamp 1986:229), and northwest Baja California. I question whether this plant would grow in such a dry place as the south end of the island and reserve judgement about its occurrence on the island. See Enrique Meling, p. 52.

Stillingia linearifolia S. Watson, Proc. Amer. Acad. Arts Sci. 14:297. 1879.

The circumstances for this species closely paralliel those described above for *Chamaesyce melanadenia*. Rogers (1951, fig. 21) showed a dot for Guadalupe Island on his map for this species; and in the list of specimens (p. 248) he cited *E. Palmer 785* (F, GH, US) from "lagoon head, Guadaloupe Island." At least one of these specimens (F) has the printed "Lagoon Head" label with "Guadaloupe Island" written below. However, number *785* again falls in the series for Lagoon Head and inland rather than in that for Guadalupe Island (McVaugh 1956:239, 230); and Vasey and Rose (1890:12) cited this collection as from Lagoon Head. Thus this report for Guadalupe Island likewise seems clearly mistaken.

In tabulating plant distributions on the Channel Islands of California plus Guadalupe Island, Dunkle (1950), on the pages shown, marked for Guadalupe Island the following plants for which I have found no other record: *Cryptantha clevelandii* Greene var. *hispidissima* (Greene) I. M. Johnst. (pp. 306, 330), *Echeveria greenei* (Rose) A. Berger [= *Dudleya greenei* Rose] (p. 304), *Lycium richii* A. Gray var. *hassei* (Greene) I. M. Johnst. [= *L. brevipes* Benth. var. *hassei* (Greene) C. L. Hitchc.](p. 306), and *Senecio lyonii* A. Gray (p. 307). Assuming these to be clerical errors, I exclude them pending further evidence. Apparently Dunkle never visited the island.

In a list of San Clemente Island plants also growing on one or more of the other Channel Islands and the adjacent mainland, Raven (1963:298) starred the name of *Cressa truxillensis* var. *vallicola* to show it was also on Guadalupe Island. I have seen no other record and think this probably a clerical error.

Wiggins (1980) cited for Guadalupe Island the following previously unreported species: *Amsinckia spectabilis* Fisch. & C. A. Mey. (p. 217), *Galvezia juncea* (Benth.) Ball var. *juncea* (p. 495), *Harfordia macroptera* (Benth.) Greene & Parry (p. 168), *Hemizonia streetsii* A. Gray (p. 37 but not p. 362), *Navarretia hamata* Greene ssp. *hamata* (p. 465), *Polycarpon depressum* Nutt. (p. 622), and *Ruppia maritima* L. (p. 953). Dr. Wiggins visited the island only once, in April 1958, with Sherwin Carlquist, W. R. Ernst, and me; and we collected pretty much together. The list of Wiggins and Ernst collections includes none of these species, and I believe he collected none of them. Wallace (1985) showed some of these species for Guadalupe Island in his distribution table, but for each he referred to Wiggins (1980), thus saying that he neither accepted nor denied the report.

I have seen no specimens and no other record of any of these species from Guadalupe Island, and I exclude them all from the list of Guadalupe Island plants for want of evidence.

Acknowledgements

During the half century of my interest in Guadalupe Island, so many people have helped in so many ways that I can scarcely even list them. First, I am grateful to the Mexican officials who granted permission to visit the island and to collect plants, to all those who helped me reach the island, including many captains and crews, and to my various companions ashore. I think first of George Lindsay and our great island adventure of 1948, with Lewie and Marcho Cavanagh on their 36-foot ketch *Marviento*, and of his continuing help and support. Then I am especially indebted to Professor Carl Hubbs of the Scripps Institution of Oceanography, who kindly included me on many of his trips and who took a great interest in my work with the plants. Others who took me on valuable and memorable trips to the island, include the Pacific Project of the Smithsonian Institution, Harold Pringle on *Pastime*, Bill Libby and his pinecone crew, Margie Stinson and Capt. Eddie McEwan on *Pacific Queen*, and Dr. Martín González and the Mexican Navy.

For the use of their specimens and for many other courtesies I thank the curators of the following herbaria: CAS, GH, NCC, ND, NY, RSA, SD, UC, US. Particularly helpful with references from library and herbarium were Annetta Carter, Judy Gibson, and Billie Meeder. Martín González kindly lent me his copy of his valuable report to the Mexican government on the natural resources of the island.

Among the botanists who have given information or advice about particular plants, often of their favorite families, are Marion Cave, Lincoln Constance, Alva Day, Lauramay Dempster, Wally Ernst, Paul Fryxell, C. L. Hitchcock, Fran Hommersand, Tom Howell, Ivan Johnston, Bill Libby, George Lindsay, C. H. Muller, Bob Ornduff, Peter Ray, Peter Raven, José Rico C., Reed Rollins, Tim Ross, Dale Smith, John Strother, Charles Uhl, and William A. Weber.

Walter and Irja Knight gave advice and help with the photographs and other matters, Colleen Sudekum drew the maps, José Delgadillo made the climatic diagram, and Dr. Alejandro Rodríguez kindly translated the abstract into Spanish.

Those who have reviewed the manuscript or read large parts of it, catching small and large errors and suggesting improvements, include Frank Almeda, Claire Brey, Tony Burgess, Sherwin Carlquist, Tom Daniel, Steve Junak, Chuck Quibell, Peter Raven, and Bob Thorne.

To all these good people I am grateful for their invaluable help at various stages of this work.

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